PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

AUGUST 1956

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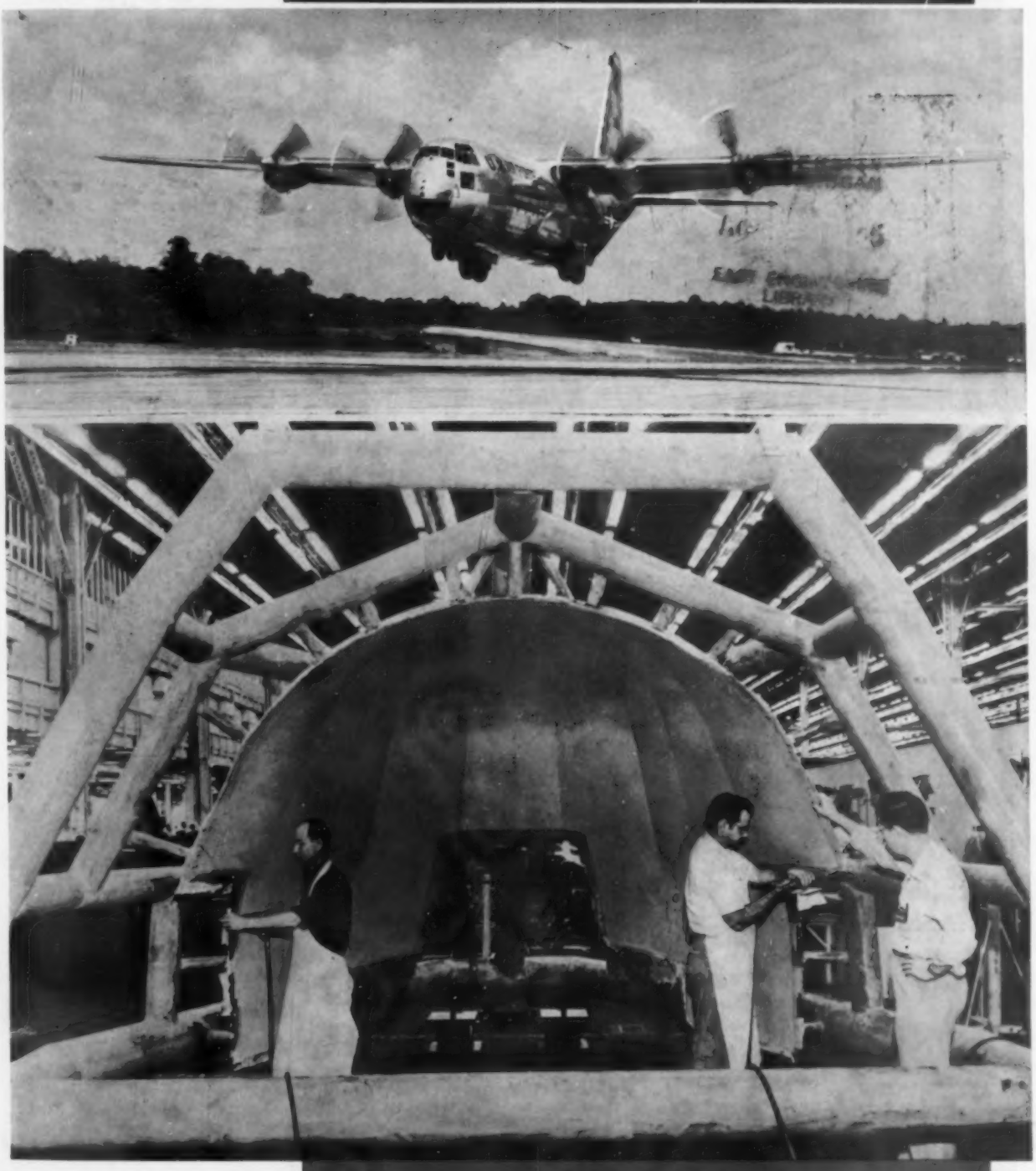

GLASS-EPOXY PLASTIC TOOLS USED IN PRODUCING THE HERCULES C-130 TURBO-PROP TRANSPORT PLANE

See feature story page 534

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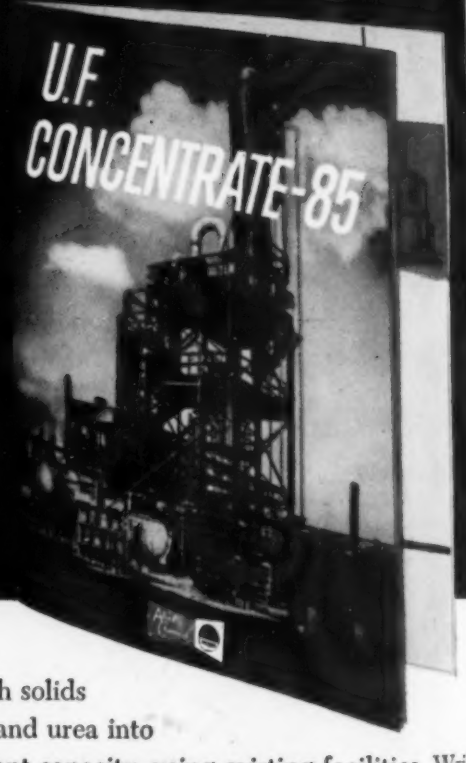

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Letters to the Editor

Is This Cooperation?

(Following are excerpts from "An Open Letter to the Plastic Industry" by Mr. Sandberg)

In reading the various publications . . . one finds that all leave a sugary taste; an impression that all's perfect in Plasticland. Nowhere . . . is there . . . a single word of official comment, dissent, criticism, or protest on the most arbitrary manner (of the major material companies).

. . . I do not criticise, find fault with, or challenge their right to increase prices. What I am particularly aggrieved with is the timing (of these increases) and the deliberate absence of any forewarning.

We (the molders) present our products with prices based on current material costs. We are forced to make price concessions, freight allowances, special promotion discounts, and pare our prices to the bone, always skimming along dangerously thin margins.

. . . When our lines are set, quotations established, and catalogs and price lists mailed out to the trade, the powder companies very quietly and without publicity throw a price increase at you.

If this is not a high-handed, outrageous, and brutal approach to customer dealings, then you name one. . . . Is this manifesting any regard or concern for the welfare of the industry?

. . . If these (materials suppliers) feel they are entitled to a price rise, they know pretty well in advance when this increase would take effect, and they should decently forewarn the industry in time for us to include these advances in our cost calculations before we start our selling season.

If the powder companies are at all sincere in their desire to cooperate and help the processors of their materials, I would by very happy to present to them a series of suggestions as to how they could be of real help in bringing our part of the industry into a decent profit structure.

. . . It is not a very healthy atmosphere (when a so-called "growth industry") shows the lowest percentage of profit returns as compared to the old line industries.

Harry O. Sandberg, Pres.
Northeastern Plastics, Inc.
Boston, Mass.

(We agree that Mr. Sandberg's comments have merit, and have invited him to write a Guest Editorial on the subject for publication in a forthcoming issue. Meanwhile, we would be interested in receiving comments from our readers. —Editor)

• • •

Agrees with Editorial

Dear Sir:

The editorial, "Sharing Industry Responsibilities" (April-June 1956), should have been published years ago and periodically thereafter as a constant reminder.

The materials suppliers, I think, are definitely not at fault. They have materials and technical data that are designed for most applications.

Emphasis should be placed with the molder that above all factors, he should incorporate the material best suited for the application. If he does not follow this practice, it not only injures his customer and the material supplier, but also himself.

The writer believes that your editorial is well founded and very explicit and to the point. If all molders, fabricators, etc., would adhere to your editorial policies concurrent with the "Statement of Principles of the Plastics Industry," everyone would enjoy the excellent plastic relationship that is available.

C. Van Deventer, III, Pres.
National Plastics, Inc.
Knoxville, Tennessee

• • •

Comments on Editorial

Dear Sir:

In general, my associates and I agree with the basic premise in your editorial, "Sharing Industry Responsibilities" (April-June), that most material suppliers ignore their responsibility to the molder and ultimate customer for the proper application of materials. Ten years ago this practice was most widespread, but we believe that we can see

encouraging signs ahead for the recognition of this responsibility.

Some suppliers try to indicate their interest by insisting that the molder specify the end use for the material, so that he could at least make a rough check of the application. We agree that this has largely gone by the way in a competitive market.

More power to you in these kind of editorials, and we hope that you will see encouraging results for such a crusade.

A. R. Taggart, President
P. R. Mallory Plastics, Inc.
Chicago, Illinois

• • •

Preservation of Coins

Dear Sir:

I would very much like advice on a thin, transparent material with total or near total absence of sulfur, nitrate, or other deleterious matter for purposes of preservation of new, uncirculated coins of various metals. Also, advice on a method of sealing the material against air or moisture entrance.

Louis Sopata
Santa Monica, Calif.

(Comments are invited on the selection of plastic film for coin preservation. These comments can be published here or transmitted directly to Mr. Sopata, as desired by the writers.—Editor).

• • •

Flowable Conductive Material

Dear Sir:

We are developing a punch card reader for use in programming our automatic control circuits for proportioning by weight, and are faced with the problem of determining a suitable conductive material which will flow under pressure to use as a sensing element and hope to find a plastic which will meet specifications. We would appreciate any information you can forward to us regarding this matter, or suggestions on how to obtain information.

V. J. Soojian, Project Engineer
Richardson Scale Co.
Clifton, New Jersey

(Can our readers supply any assistance in this matter?—Editor)

• • •

Plastic Letters Wanted

Dear Sir:

Do you know of anyone molding alphabet letters from ½-inch in size and up? Type of material is not particularly important to us; the range of letter sizes and styles are of greater importance.

James A. Norris
Sign Art Supply Co.
Baton Rouge, La.

(Several possible suppliers have been given the inquirer. Additional sources of supply are invited.—Editor)

• • •

Plastic Lacing Sources

Dear Sir:

Can you tell us where we may obtain curled plastic lacing? We want this to wrap around wire handles.

D. Moore
The Delsam Co.
Wilmington, Del.

(Two possible sources of saran lacing have been furnished Mr. Moore. Any further suggestions from our readers? —Editor)

• • •

Viscoloid or Viscoid?

Dear Sir:

Regarding the letter in your July issue (page 432) on "Who Makes Viscoloid," it may be that the inquirer has in mind a plastic material, Viscoid. This is a water resistant viscose compound, and was manufactured by Monit Co. in Heidenau, near Dresden, Germany. You will find more about this material in my book, "Das Celluoid," as well as further information on Viscoloid.

G. L. Bonwitt, Consultant
New York, New York

(Our thanks to Dr. Bonwitt. This additional information has been forwarded to J. J. Conradi, the original inquirer. —Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

—The Editor

"Quote . . . Unquote"

Packaging With Polyethylene

"The inherent properties of polyethylene film make a 'natural' for packaging. It has a relatively low cost, and gives good product protection because it is tough, flexible, moisture proof, tasteless, odorless, nontoxic, and chemically inert. Most polyethylene film is extruded (although it may also be cast or calendered), and an acceptable degree of transparency is obtained in the light gauges.

"In a two-year period, polyethylene film for packaging has increased almost fourfold from an estimated 25 million pounds in 1953 to approximately 97 million pounds in 1955 (representing about 75% of the estimated 130 million pound total polyethylene film production). And this is only the beginning—predictions for 1960 indicate a possible 300 million pound production of polyethylene film with 225 million pounds in the packaging market alone."

"Polyethylene Film in the Flexible Packaging Market." A market study by Monsanto Chemical Co., Plastics Division, Springfield, Mass.

• • •

Industry's Role in Education

"The scientist or engineer should be trained as much as possible in the other attributes which will make him an effective human being. Science itself, if taught as a system of thinking and not as simply a body of knowledge, can be one of the most effective methods of such training.

"The complex, highly technical and expanding America of the future will demand the best leadership America can produce. It is up to the American people and American industry to see the problem and see to it that it is solved.

"We cannot do this by criticizing our schools. Educators by and large are dedicated people doing their best to supply what the public wants with the means the public provides. We, and specifically, industry must help. We must provide our share of the resources education requires. Industry people should make their abilities available by personally taking part in . . . established means of school cooperation. We will have to use our best efforts to induce pupils, parents and teachers to raise their sights to higher objectives."

Gen. J. E. Hull, President
Manufacturing Chemists' Assn.
Washington, D. C.

• • •

(Continued on page 540)

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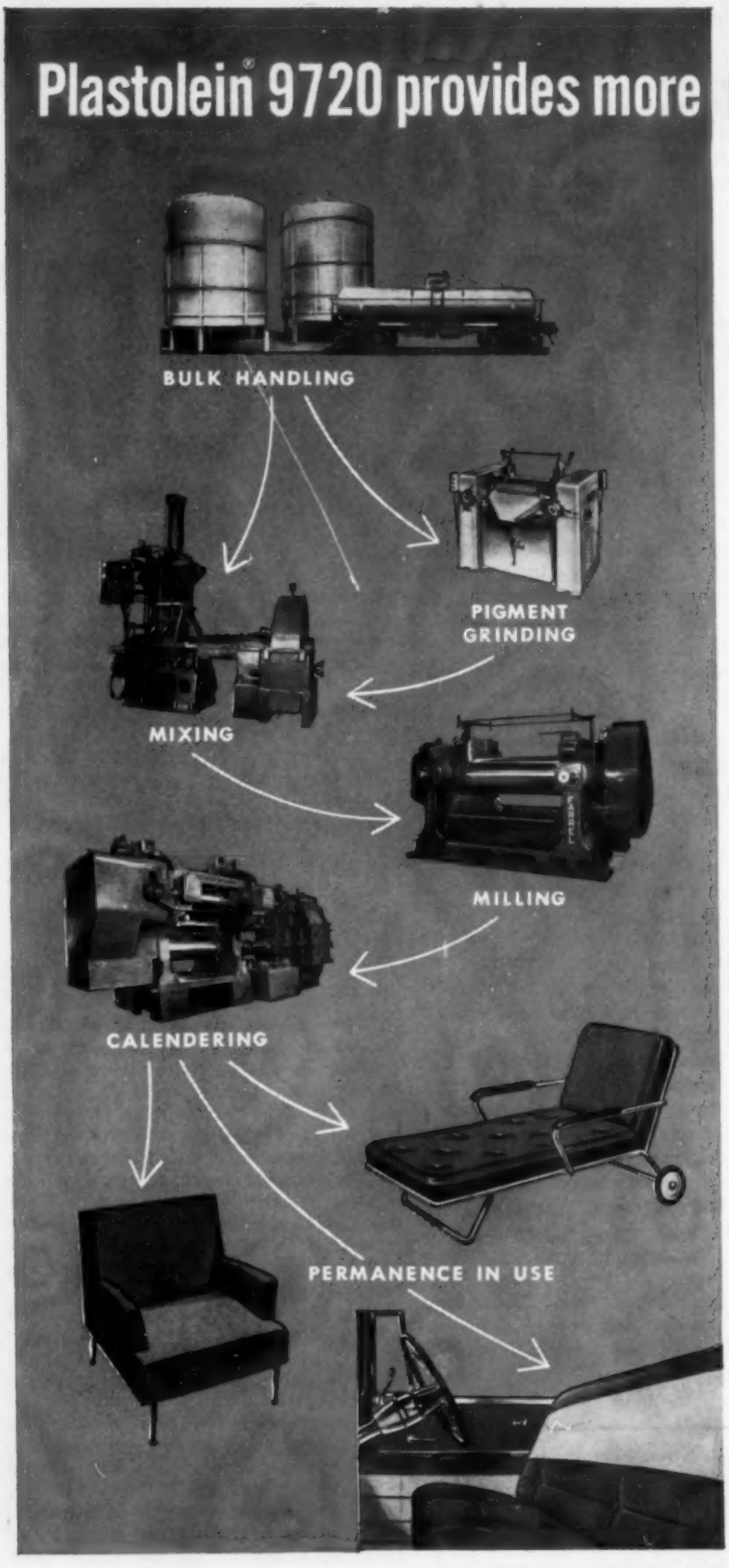

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NEWS in BRIEF

Housewife prejudices against plastic housewares are waning, according to a recent DuPont survey in "Plastictown, USA," an existing city of 100,000 chosen for its representative nature (see page 542). The survey covered such topics as likes and dislikes, popularity, color preferences, and need for informative labels on the plastic items. These housewife preferences and buying habits in housewares are expected to guide plastics industry in improving its consumer plastic products.

Polyethylene film is expected to protect millions of acres of crop land in the next decade, a Bakelite spokesman says. Agricultural uses of the film provide for inexpensive control of weeds, disease, and mold rot; reduce irrigation costs; protect crops during silo storage; and produce more and better fruits and vegetables.

Vacuum metallizers of plastic films formed a new trade association to promote product standardization; collect and disseminate data; advance fair trade practices; and act as spokesman for this industry.

Polyethylene terminology confusion is discussed and a solution is proposed by M. W. Davidson of Phillips Chemical (see guest editorial, pages 522-3). Classification of polyethylenes according to their relative rigidity is suggested, since rigidity can be determined by simple physical measurements and is a term understood to a meaningful degree by the public.

Company developments in the news this month include dismissal by the Supreme Court of the cellophane anti-trust suit against DuPont; Clopay's acquisition of Closures, Inc., makers of plastic and reinforced folding doors and room dividers; and the purchase by Interchemical of the adhesives business of Angier Products, which will now operate as a division of Interchemical.

Company expansions in plastics remain at full flood. Alsynite has completed its new office building in San Diego, Calif. DuPont will increase production of methyl methacrylate monomer at Charleston, W. Va., and coating facilities for Mylar film at Circleville, O. Eagle Rubber purchased a two-story building adjacent to its Ashland, O., plant site. Glass fiber manufacturing operations of Famco at Louisville, Ky., are being extended to include production of reinforcing and decorative mats, and surfacing. Fischer & Porter is erecting a new office building in Hatboro, Pa. Glastic is expanding floor space and manufacturing facilities at Cleveland, O., by 50%. Koppers plans a new research center near Monroeville, Pa. Pennsylvania Color & Chemical will enlarge its pigments plant at Doylestown, Pa.

New Materials to be noted this month (see pages 548-9): amine-type hardener for epoxy resins; two-component polyurethane foam formulation; vinyl organosol formulation; two higher-crystallinity polyethylene resins; dehydrogenation catalyst for styrene production; adhesive for bonding polyurethane foams; and a conductive organic coating.

New Equipment of interest (see pages 550-1): series of intensive mixers; automatic vacuum-drape forming machine; bench-model punch press; line of four-post hydraulic platen presses; vacuum forming and trimming machine; and a low-pressure steam boiler.

New Products worthy of mention (see pages 552-3): acid-resistant fender covers for autos; copper-clad laminates for printed circuits; one-piece glass-reinforced polyester boat hulls; vinyl-nylon laminate coverings; extruded nylon window strips for marine applications; sprayable vinyl plastisol; box of plastic sandwich construction for carrying airline meal trays; moisture-proof plastic film for food packaging; glass-reinforced polyester pool for aquatic plants; and continuous rolls of vinyl plastic patent leather.

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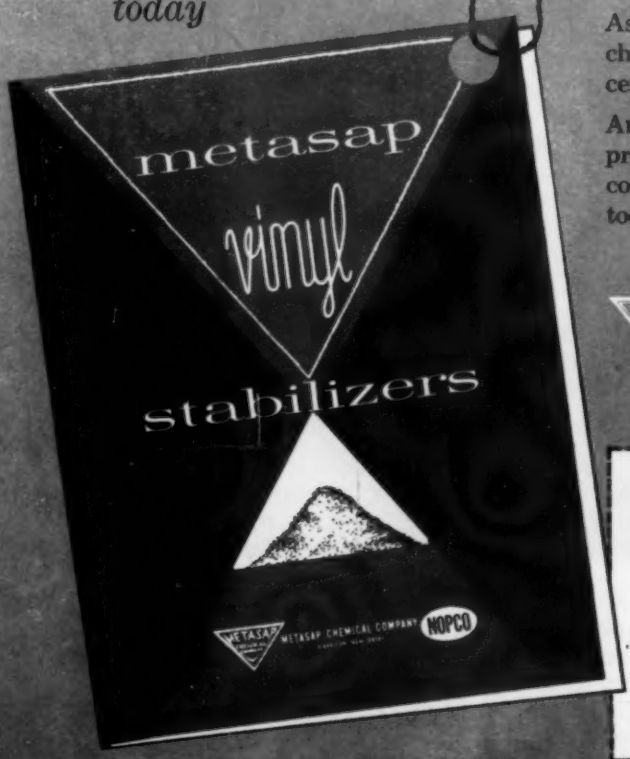

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PLASTICS TECHNOLOGY

AUGUST, 1956

EDITORIAL: Improving the Plastics Exposition

Last month's editorial discussed some of the shortcomings of the Seventh National Plastics Exposition in June. It was noted that while the show continued to trend away from products that could be termed only as colorful novelties, there still were too many displays of improperly engineered products—misapplications, if you will—where plastics were used solely for color or other striking effect, rather than because they met the service requirements of the part. This, of course, is a problem whose solution must await the coming of age of the plastics industry, and the acceptance of plastics as true engineering materials to be used only as such.

•

Actually, any discussion of this exposition and plans for future shows should begin with the fundamental question: Should the plastics exposition be industrial in nature or should it be a marketing show? In other words, should the exhibits appeal to the plastics industry and its industrial customers, or should they promote the marketing of plastic products to the consumer? There is another alternative—should it do both?

This question has not been answered as yet, and the expositions to date have been compromises trying to do both jobs and failing to fully satisfy either. If the show is to continue as a combination, the exhibits should be classified and grouped into two distinct sections, easily identifiable.

•

Another problem to be settled is that of registration. Although past shows have been closed to the public, even a casual survey of the visitors reveals many persons who are either not in the plastics industry, or else only remotely connected with plastics. In the first group are the wives, children, relatives, and friends of the exhibitors. They attend in great numbers, clog the exhibit aisles and display booths, and concentrate on obtaining all the available free samples.

This group of "families and friends" can be eliminated by rigid controls over registration, with checking the credentials of all prospective registrants. At the same time, exhibitors should sign a strict agreement to limit their pre-show registration cards to persons in the plastics industry.

The second group of non-industry visitors is interested in plastics marketing, and consists of wholesalers, dealers, distributors, and buyers of consumer plastic goods. With proper separation of the exhibits, visitors in this group could be given distinctive badges upon registration that would permit them to enter only that section of the exposition devoted to marketing of plastics.

Finally, as a sop to human nature, we would recommend that the exposition be open to the public for a limited period of time. This would serve to satisfy the curiosity of "friends and families," and also help acquaint the general public with the constant advances being made in the dynamic plastics industry.

Arthur M. Merrill

Editor

Indoors or Outdoors

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Harry Edward Arnold was born in Mechanicsburg, Pa., in 1921, and received a B. S. in chemistry from Albright College in 1942, and an M. S. in chemistry from the University of Delaware in 1950. He joined Du Pont's Explosives Department in 1942 as a chemist at the Indiana Ordnance Works. Later that year, he went to the Oklahoma Ordnance Works as a chemist. In 1944, he transferred to the company's Burnside Laboratory as a chemist on product development problems. He has held his current post since 1953.

Mr. Arnold is a member of the American Chemical Society, the American Association for the Advancement of Science, and the American Ordnance Association. He resides in Claymont, Del., with his wife and three children.

Chemical Blowing of Cellular PVC*

A detailed discussion of methods for making cellular PVC, with emphasis on plastisol formulations, equipment and process conditions.

H. E. ARNOLD, *Technical Representative,*
Product Development, Chemical Sales, Explosives Department,
E. I. du Pont de Nemours & Company, Inc.
Wilmington, Del.

CELLULAR polyvinyl chloride plastic is a relatively new material whose birth dates back to World War II and the development in Germany of the unicellular type which contained individual, non-interconnecting cells. It was not until the past few years that the preparation of open-cell PVC sponge, now generally known as vinyl foam, was found to be feasible. End-uses for the closed-cell type are now fairly well defined, but studies are under way to delineate the fields of application for the open-cell type. The cellular PVC industry is developing rapidly and shows promise of substantial future growth.

Cellular PVC shows all the characteristics of conventional PVC sheet made from plastisols, plus lightness and excellent insulating properties. The coefficient of thermal conductivity is lower than that of the commonly-used insulating materials. One of the outstanding properties imparted by PVC to the finished cellular product is superior flame resistance over other cellular plastics and foamed latex. Accordingly, this relatively new cellular material is expected to find many household uses in which non-flammability is highly desirable.

* Based on a paper presented at the twelfth annual National Technical Conference, Society of Plastics Engineers, Inc., Cleveland, O., Jan. 19, 1956.

Applications for Cellular PVC

Cellular PVC, like solid PVC, is thermoplastic and, hence, softens upon heating. Therefore, for some applications involving service under load at elevated temperatures, cellular PVC may not be suitable. The value of thermoplasticity must not be overlooked, however, since this characteristic is of decided advantage for uses involving electronic welding or heat sealing. Odor and plasticizer migration are potentially undesirable attributes which may preclude the use of cellular PVC in certain critical applications. In recent months, considerable progress has been reported in efforts to eliminate these deficiencies and reduce thermoplasticity through careful compounding.

Possible outlets for cellular PVC resin are numerous and cover widely separated fields from cushioning to insulation and construction, and from soft pillows to jacket linings and core materials in wall panel fabrication. Closed-cell PVC is ideally suited and in demand for buoyancy, flotation, and similar applications where non-interconnecting cells are necessary to good performance. Open-cell vinyl foam is finding applications where coolness, comfort, and economy are of paramount importance.

It is extremely difficult at this early stage to estimate the total market in the United States for cellular PVC, since competitive products are seeking the same market. Some public forecasts have been made, however, and range from 75,000,000-200,000,000 pounds of flexible vinyl foam by 1960 in a market where total consumption of all types of flexible foam conceivably could reach 400,000,000 pounds annually by that year (1).** Market potential for the older, closed-cell type is not reflected in these data, since volume figures are not available although steady growth is forecasted.

Thus, outlets for vinyl foam are expected to be large. Whether or not the anticipated markets will be realized will depend, in the final analysis, on cost and performance in competition with the other new types of foams as well as foamed latex.

Use of BL-353

With the foregoing introduction, we would like to discuss how cellular PVC may be produced through the use of BL-353 chemical blowing agent. This material has attained considerable prominence as the gas-generating agent in the formation of both closed- and open-cell PVC resin.

BL-353 is an organic mixture consisting of approximately 70% N,N′-dinitroso-N.N′-dimethyl terephthalamide and 30% inert diluent. It decomposes smoothly and fairly rapidly before the gelation temperature of the plastisol or plastic mass is reached. This is the characteristic which makes BL-353 unique among available blowing agents, and of special interest for producing resilient and semi-rigid open-cell vinyl foam at atmospheric pressure. Since BL-353 releases nitrogen upon thermal decomposition, it is equally useful in the formation of closed-cell products.

The advantages seen for the BL-353 chemical blowing method can be listed as follows:

(1) Produces both cellular types of expanded PVC.
(2) Permits wide range of densities.
(3) Results in excellent cellular uniformity of product.
(4) Allows wide latitude in compounding.
(5) Permits mixing of plastisols to yield composite properties.
(6) Produces large or small quantities with equal facility.
(7) Applicable to continuous production of open-cell foam in thin sheets.
(8) Requires no specialized equipment.

Laboratory studies have demonstrated a broad latitude in compounding plastisols, and advances in formulating technology are foreseen as the result of combined, cooperative effort of fabricators and raw materials suppliers.

With regard to the economics of chemical blowing, the cost of producing cellular PVC articles can be expected to vary with density and other specifications imposed on the finished product. The capital investment for equipment to make open-cell vinyl foam by this process is low. No equipment of special design is needed; in many cases, available mixing and heating facilities can be adapted for use, thus keeping expenditures to a minimum. Two- or three-roll mills for mixing and single- or multi-zone convection ovens for foaming and fusing are usually preferred, but certain other equipment has proven to be satisfactory. For the production of closed-cell expanded PVC, a considerably greater investment can be anticipated, since hydraulic presses or similar high-pressure equipment is required to produce a completely unicellular product.

Ingredient costs, including the cost of BL-353, at the present time start from about $0.35 per pound, based on laboratory formulations, for a resulting product in the medium-density range of 6-8 pounds per cubic foot. For closed-cell expanded PVC in the same density range, ingredient costs start around $0.45 per pound, also for laboratory formulations. In the future, lower ingredient costs can be expected to result from increased demand for components, including BL-353. Processing costs will depend on the type of equipment employed, and can be determined by the fabricator.

Figure 1 illustrates the general types of closed-cell

Fig. 1. Examples of closed-cell PVC. Slabs on platform scale (center) are of very low density. (Net floats courtesy Linen Thread Co.).

** Numbers in parentheses refer to bibliography at end of article.

PVC products being produced commercially in the United States. At the extreme left are semi-rigid net floats of various sizes ranging from 3 inches in diameter. The coiled sheet at the extreme right is a soft, flexible padding material. These products are characterized by very fine cells, low thermal conductivity, and low water absorption. Life rafts, life preservers, water-tight caissons, buoys, boat bumpers, net floats, as well as non-breathing, non-absorbent padding and lining, are but a few of the applications for this material.

Making Unicellular PVC

Conventional Method

The conventional procedure for preparing unicellular PVC, which contains permanent plasticizer, involves a two-step operation patterned closely after the method for making unicellular expanded rubber. In brief, the process may be described as follows: A cold-milled mixture of PVC, BL-353, plasticizer, stabilizer, and filler (if desired) is placed in a gas-tight, leakproof mold, usually steel, and heated under pressure for a period of time sufficient to decompose the BL-353 and to fuse the plastic mass. After cooling, while still under pressure, the molded piece is removed and expanded fully by warming in either hot liquid or hot air. Using this technique, it is possible to make rigid and semi-rigid products with minimum densities of 4-5 pounds per cubic foot and soft, flexible material with a minimum density of about 2-3 pounds per cubic foot.

A wide selection of ingredients is permitted when BL-353 is used. Copolymer and homopolymer vinyl resins have been used successfully. The flexibility and other physical properties desired in the end-product largely govern the types and amounts of plasticizer, plasticizer extender, and filler. Most of the commercially available stabilizers are satisfactory. In addition, up to 70 parts BL-353 per hundred parts of resin (phr) may be used without incurring charred sponge centers, imparting odor, or resulting in staining.

The liberation of gas from the blowing agent results in a high pressure inside the closed mold which aids in the uniform dispersion and dissolution of the nitrogen in the plastic mass. In one known case, employing approximately 25 parts BL-353 phr, this pressure was estimated to be in the order of 2,000 psi. Of course, the internal pressure developed depends on the quantity of blowing agent used. It must be compensated by at least an equally high external pressure to keep the mold from separating and the contents from spewing. Hydraulic, multiple-plate presses are conventionally employed to provide the necessary counterpressure.

When presses with steam-heated platens are used, heating cycles are in the order of 5-30 minutes, depending on such factors as mold design and press efficiency. Steam pressures of 75-120 psig. are usually adequate. Cooling cycles also vary, but circulation of cooling water through the platens for 5-10 minutes is usually sufficient.

For normal formulations, the plastic mass will be expanded from 100-200% as the press is opened, thereby expelling the piece from the mold. In order to obtain maximum size as well as optimum physical properties, this partially-expanded product must be heated while unconfined. As the PVC softens, the relatively high internal gas pressure further expands the individual cells, thereby significantly increasing the volume of the piece. Warming at about 212° F. is usually sufficient; if the material is heated much above 220° F., fissures and cracks may appear.

The ultimate volume attained is influenced by several factors. The most significant of these is the quantity of blowing agent included in the composition, since this is the source of gas for the expansion. In addition to blowing agent concentration, other components of the formulation may influence the degree of expansion. Mold size must be considered, and designed to accommodate the expansion which occurs in the piece upon heating after removal from the mold.

There also is the problem of shrinkage upon aging. Here, again, the degree of contraction seems to be a function of composition; thus it is difficult to predict as to magnitude and rate. It may occur slowly over a 2-4 week period or may be essentially complete within 24 hours, depending upon treatment of the material. In general, shrinkage seems related to the type and concentration of plasticizer used, being greater at higher plasticizer concentrations.

Laboratory Method

Rigid, closed-cell PVC which is very light in weight has not been produced to our knowledge by the conventional techniques just described. It has been produced experimentally by a different procedure, however. Laboratory examples are shown resting on the scale in Figure 1. These pieces represent a combined density of only 2.5 pounds per cubic foot.

This type of product is not readily damaged, is not friable, and can be cut or sliced in thin sections by conventional tools. Low cost per unit volume, lightness, and its rigidity and closed-cell structure are the principal attributes of this material. Potential outlets are insulation for home freezers, water coolers, ice cream cabinets, air-conditioners, refrigerator cars and trucks, and rooms on ships and aircraft; and as core material in sandwich construction for bulkheads, wall panels, etc.

The laboratory technique for preparing the very low density, unicellular PVC shown in Figure 1 was adapted from a general process disclosed in the patent literature (2). This involved a composition resembling an organosol rather than a plastisol, and comprising PVC resin, temporary plasticizer, stabilizer, and BL-353. The novel feature lies in the use of a temporary plasticizer which is both quite volatile and also a swelling agent for PVC resin. After expanding the composition in the previously discussed two-step operation, the temporary plasticizer is removed to give the product its maximum rigidity.

With acetone and no permanent plasticizer, it was possible to produce laboratory specimens having a very fine cell structure and densities as low as 1.7 pounds per cubic foot. Experience to date indicates that maximum expansion, hence minimum density, in the final heating step results only if the piece is removed from the mold at the highest possible temperature, just short of the rupture point of the plastic mass. Physical properties of the low-density, rigid material made in

laboratory scale with acetone as the temporary plasticizer are shown in Table 1.

Because volatile materials are needed, the mixing and handling problems are obvious. Practical solution of these problems should permit penetration of markets heretofore closed for expanded PVC.

Table I. Properties of Low-Density, Rigid, Closed-Cell PVC (Laboratory Samples)

Density, lbs./cu. ft.	1.7-3
Durometer "A" Hardness*	45-50
Compressive strength, psi*	15#
Modulus, psi	720#
Water absorption, lbs./cu. ft.**	1.2#

* Measurement taken on cut surface.
** Amount of water absorbed after air was removed in vacuum.
# Measurement made on single sample.

Atmospheric Pressure Method

In its essentials, the process for preparing chemically blown foam at atmospheric pressure usually consists of the addition of the blowing agent to a slurry of polymer and plasticizer, and the heating of this mixture to achieve foaming and fusion. At elevated temperatures, the blowing agent decomposes, releasing nitrogen which is entrapped in the plastic mass which is simultaneously increasing in viscosity as the polymer becomes solvated.

Initial plastisol viscosity does not appear to be critical to foam formulation. Compositions with viscosities as low as 200-300 cps. and as high as more than 100,000 cps. have been foamed successfully. When compounded properly, plastisols may be converted into sponge following a simple process which entails nothing more than the controlled application of heat. The relatively low temperature of decomposition, which allows the complete release of gas at a uniform rate prior to the gelation of the plastisol, is the outstanding feature of BL-353 which makes it unique in the expansion of PVC plastisols at atmospheric pressure.

Plastisol Formulation

The rheological properties of the plastisol must be adjusted to suit both the blowing agent and the resin if the plastisol is to be expanded properly and the blowing agent utilized efficiently. The temperature and rate at which the blowing agent evolves gas, and solvation of resin takes place are important factors to be considered in compounding expansible plastisols. There may be other factors equally important, but they are not known at this stage of development.

Since plasticizers vary widely in resin solvating power and may even differ in this respect with different brands of resin, selection of the plasticizer or plasticizer system must be done so that gelation will not occur until the blowing agent has decomposed. Those plasticizers which cause swelling of the resin, with attendant increase in plastisol viscosity at room temperature, should be avoided; those which cause swelling concurrently with decomposition of the BL-353 should be used. In most plastisols, decomposition of the BL-353 begins around 140° F., and is completed by the time the temperature of the composition reaches 212° F. It will be found, however, that the temperature range over which BL-353 decomposes depends markedly on the composition of the plastisol. In an inert medium BL-353 melts with decomposition at about 220° F.

Inasmuch as expansion is effected while the plastisol is in a fluid state, plastisols exhibiting a gel temperature in the range of 250-280° F. are preferred. If gas is released from the blowing agent after gelation, it fails to produce foam and is lost into the atmosphere by channeling.

In developing a suitable plastisol, consideration must be given, therefore, to the various factors which influence gelation. These include resin, modifiers, stabilizers, and extenders, as well as the plasticizer system. Just how the various ingredients interact and by what mechanism the interconnecting cells are formed have not yet been established. Moreover, the formulation of expansible plastisols is based on empirical data and, as yet, should be considered an art rather than a science.

Despite what may appear to be the limitations just cited, the formulator has a wide latitude in the selection of components for use in plastisols to be foamed with BL-353. Within limits, low-cost inert fillers may be employed to increase water absorption or to impart other unusual properties to the sponge. Coloration of the foam presents no problem, since the pigments conventionally employed with solid vinyl stocks are satisfactory for use with BL-353. Most of the commonly-employed vinyl stabilizers are satisfactory for use in expansible plastisols. These include the organo-metallic complexes and the epoxy- and soap-types, as well as the inorganic lead stabilizers. With regard to PVC itself, only dispersion grades have been converted successfully into high-quality, open-cell foam.

As for plasticizers, a combination of two or more is usually needed to impart good over-all performance characteristics to the finished sponge. In addition, the right combination is essential if good-quality foam is to be obtained. Generally speaking, the ester-types are preferred because they not only give a good balance of physical properties, but can be used to regulate the solvency of the plasticizer system. With Geon 121 resin, for example, plastisols may be compounded with polymeric or monomeric plasticizers, either individually or in combination. Thus, the technical and/or economic advantages of the two types of plasticizers may be utilized as the experience of the formulator dictates.

The relative proportion of a particular plasticizer is governed largely by the amount of total plasticization. If from 100-125 parts plasticizer phr are used, then strong solvating types in moderate amounts may be incorporated. If the level of plasticization is in the range of 60-80 parts phr, then the use of the low-solvating types of plasticizers is to be preferred in order to insure decomposition of the BL-353 prior to gelation.

Extensive formulation studies have shown that the gelation point of a plastisol may be modified also by using certain plasticizer-soluble metal salts of alkyl aryl petroleum sulfonates. Calcium salts of this type are especially effective when the plasticizer system is predominantly monomeric and low densities are desired.

At 1-4 parts phr, the salt tends to retard the solvation of the resin, as evidenced by a lowering of the plastisol viscosity during the foaming cycle.

Small amounts of sodium lauryl sulfate and calcium oxide, in the order of 1-2 parts phr, in combination with certain barium-cadmium-epoxy stabilizers also are beneficial in depressing viscosity and retarding gelation. The individual and cumulative effects of these components on the viscosity-temperature properties of plastisols are shown in Figure 2.

In this figure, Plastisol A is:		
PVC paste resin	100	parts by weight
Didecyl phthalate	35	parts by weight
Fatty acid ester	15	parts by weight
Di-2-ethyl hexyl hexahydro phthalate	35	parts by weight
Didecyl adipate	15	parts by weight
Plastisol B is:		
Plastisol A, plus		
Liquid Ba-Cd stabilizer	3	parts by weight
Liquid epoxy stabilizer	2	parts by weight
A calcium petronate	3.6	parts by weight
Plastisol C is:		
Calcium oxide	1.	parts by weight

As would be expected, the plasticizers used largely govern the properties of the product, except for density. Interesting characteristics, thus, may be compounded into vinyl foam by choosing the appropriate plasticizers. Some of the properties which may be controlled by the type of plasticizer system employed include resiliency, flame resistance, energy absorption, toughness, hardness, low-temperature flexibility, mar resistance, compression deflection, and compression set.

Chemical blowing is capable of producing vinyl foam in a wide variety of properties. Compression may be varied by the amount of blowing agent as well as by the amount (60-125 parts phr) and type of plasticizer.

Mixing

In order to insure no sacrifice of potential quality, components of the formulation must be mixed thoroughly and uniformly. Failure to do so may result in (1) inefficient expansion; (2) formation of cavities or voids; (3) surface imperfections; or (4) irregular and coarse cell structure with the attendant variations in some of the important physical properties of the foam.

Mixing equipment which imparts considerable shear gives best results. For example, a water-cooled, three-roll paint mill produces a dispersion which results in excellent quality vinyl foam. Most of the mixing equipment commonly used for blending the plastisols should be satisfactory if the temperature during mixing can be maintained at 120° F. or lower. At higher temperatures, a slight loss of gas may occur during mixing.

BL-353 may be dispersed in certain plasticizers by one pass through a tight, cold, two- or three-roll mill as a masterbatch for use within a relatively few hours. In this case, the resin is added in small increments to a portion of the masterbatch admixed with a sufficient quantity of plasticizer. Simple stirring, then, completes the mixing.

Conversion

As previously mentioned, conversion of the expansible plastisol to open-cell foam broadly entails no more than the controlled application of heat. Specific conditions may vary depending on the formulation, the rate of heat transfer of the mold or substrate in use, the type and size of oven or other heating equipment, and the thickness and density of the product. Therefore, optimum time and temperature cycles must be established for the available equipment.

Essentially, the conversion takes place in two stages. First, heat is applied at a rate which does not produce gelation of the plastisol prior to the complete release of gas from BL-353. As nitrogen is evolved, it converts the plastisol into a foam which is tender, but stable to careful handling. Foam as high as 18 inches has been prepared in a cylindrical tube, but only foam from 6-7 inches in height has been fused successfully. The second stage of the process is a further heating to bring about fusion of the resin in order to impart optimum physical and mechanical properties to the product. The plastisol passes through these two stages whether conversion is accomplished at one or two temperature levels.

For cored or uncored slab stock in the density range of 6-8 pounds per cubic foot with cross-sections between 1-3 inches, it is often desirable (but not necessary) to conduct the expansion and fusion as separate steps initially, at 212° F., and finally, at 325-350° F., in a two-zone, conveyor-type oven. Plastisol may be expanded and fused in an oven at a single high temperature (about 350° F.) if it is shielded during foaming from direct exposure to hot air. A metal cover or lid is quite satisfactory, provided that it does not come in contact with the foam. In order to produce a sponge with density of 4-5 pounds per cubic foot, it is necessary to initiate foaming at a low temperature, say 175° F. and complete the expansion at 212° F.

The total cycle will vary from 20-50 minutes, depending on the temperature of the heating chamber, the size of the expanded object, and the composition and amount of plastisol.

(Continued on page 533)

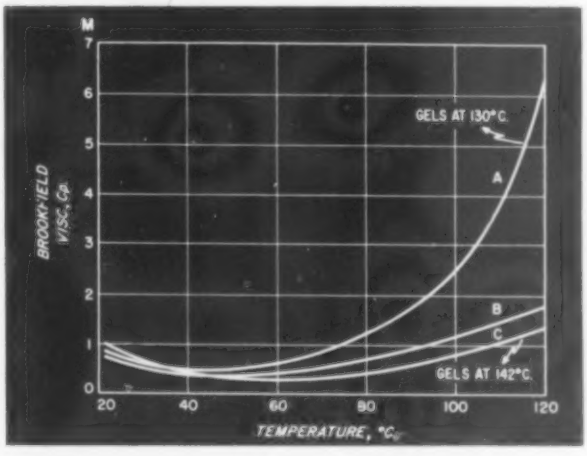

Fig. 2. Effect of additives on plastisol viscosity and temperature.

Guest Editorial

Suggested Terminology for the New Polyethylenes

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WITHIN recent months, PLASTICS TECHNOLOGY has posed editorially a number of broad, pertinent questions regarding terminology, properties, and fabrication characteristics of the new polyethylenes. It is the purpose of the following comments to discuss briefly some aspects of polyethylene terminology and offer suggestions for solution of this important problem.

At the outset, it is important to avoid the confusion which seems certain if the new polyethylenes are categorically referred to as "low pressure" polyethylenes. For example, a family of polymers, of which Marlex 50 ethylene polymer is only one, will be made by the Phillips Petroleum Co. low pressure polyolefin process. These polymers will embrace a wide range of characteristics, including that portion of the ethylene polymer property spectrum now occupied exclusively by the so-called "high pressure" commercial polyethylenes. The identity of the various polymerization processes as such is likely to have diminishing importance in future industry thinking as all polyethylenes come to be classed and used in keeping with their specific physical properties and fabricating characteristics.

Establishment of a nomenclature system adequate not only for presently-known ethylene polymers, but also applicable to future generic types, is a substantial undertaking. Suggestions in the industry for designating the new polyethylenes have included "high modulus" and "high density." Modulus, alone, is a somewhat nebulous term unless carefully defined, and is subject to the widely varying interpretations of such scientists as the engineers, the physicists, the rubber technologists, and the numerous plastics specialists.

Density is directly related to the basic property, degree of crystallinity. As such, it implies the relative magnitude of a number of other important properties such as stiffness or rigidity, permeability, and softening point. Thus, density is a reliable scientific term, particularly when based on a

thoroughly specified method of sample preparation and subsequent measurement of values to the third decimal place. However, density has little or no significance to many people outside of the plastics industry, particularly the consuming public.

Ideally, a thoroughly effective nomenclature should be based on simple, accurate physical measurement, and reflect to a maximum degree of completeness and accuracy the basic physical properties of the polymers. In addition, a designation meaningful to the consuming public would be highly beneficial to the plastics industry in furthering the acceptance and satisfactory use of the different polyethylenes.

Classifying polyethylenes according to their relative rigidity appears scientifically accurate in implying other basc physical properties related to crystallinity. Rigidity is readily based on simple physical measurement (e.g., ASTM D747-50). Also, "rigidity" can be understood in a meaningful degree by the public.

Referring to a new polymer such as Marlex 50 as "rigid" polyethylene appears substantially more dsecriptive than "high density" or "high modulus" and provides for designations of other types within the industry as "semi-rigid" and "flexible," somewhat analogous to the "impact" classification of styrene plastics. With further establishment of new types, such a system may pave the way for a considerably more complete means of industry classification which takes into account, indirectly, the two factors that control polyethylene properties; namely, crystallinity and molecular chain length.

Increasing crystallinity yields increasing rigidity, density, softening temperature, tensile strength, and impermeability, with decreasing impact strength and elongation (at high rates of pull). Increasing molecular chain length yields increasing impact strength and stress-cracking resistance and decreasing brittle point and melt index.

Over-all polyethylene classification in terms somewhat more familiar than crystallinity and molecular chain length could, for technical trade purposes only, be based with equal validity and meaning on both density and melt index. In such a suggested system, one of the present commercial molding grade polymers would be designated 0.920/1.8 and Marlex 50 polyethylene would be 0.960/0.7.

Designating the new polymers by a name other than polyethylene is certain to lead to confusion throughout the industry. A rigid polyethylene is in reality as truly a polymer of ethylene as a flexible polymer, the two differing basically only in molecular structure or crystallinity and molecular chain length.

The great amount of interest in the new polyethylenes attests to the progressiveness of the plastics industry, alert to the tremendous broadening of horizons the new polyethylenes are bringing with their vastly improved and different combinations of properties. The possibilities for new plastics applications are almost unlimited with the prospective development of altogether new olefin polymers and copolymers. Sound, adequate technical trade terminology for these future materials can be adapted readily by suitable modification of the above-suggested system. —The End

Nylon Replaces Brass in Submersible Pump

Nylon, together with stainless steel, has replaced brass as the basic material used in the stages of a new submersible pump, the Dolphin, developed by Dayton Pump & Mfg. Co., Dayton, O. All moving parts within the pump that are subject to abrasion are made of nylon, while all other parts subject to abrasion and corrosion are made of stainless steel.

The hydraulically-balanced impeller is made of nylon, while the micro-smooth case is of stainless steel. In addition to being form-stable, the nylon absorbs the shocks and impacts of sand and other foreign particles in the water being pumped. The coefficient of friction between nylon and stainless steel is very low, particularly in water, providing for added pump efficiency.

Suitable for use in wells ranging up to 500 feet in depth, the Dolphin pumps are available in sizes ranging from 7-21 stages, capacities to 1,000 gallons per hour, and pressures to 80 pounds. —The End

Dolphin submersible pump (Right). Cross-sectional view of pump showing nylon impeller (Left).

D. A. DEARLE, *Plastics Division Manager, North & Judd Mfg. Co., New Britain, Conn.*

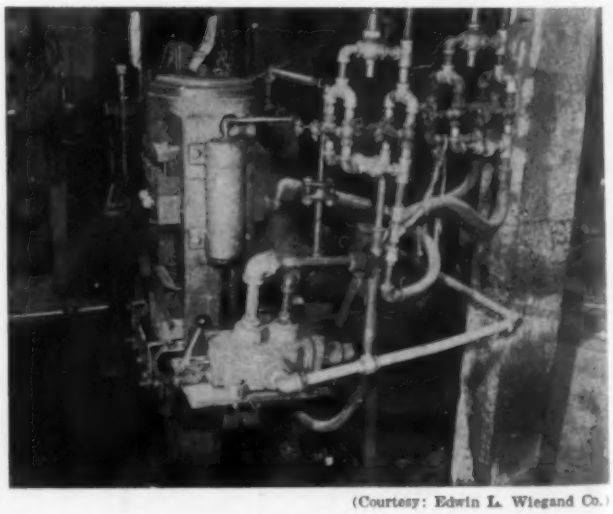
Heating Media for Compression Molds

A discussion of the comparative advantages and utility of gas-fired, hot water, steam, and electric heating methods.

It is axiomatic that either heat or a combination of heat and pressure must be applied to raw plastic materials in order to produce molded parts. Heat causes polymerization of thermosetting compounds, whereas the higher temperatures applied to thermoplastics merely change their physical structure. The great bulk of plastic products is made by either compression or injection molding. Extrusion is limited to the processing of continuous lengths of thermoplastic materials. Compression molding is the most widely used method for converting thermosetting compounds into finished products. Compression molds may be heated in a number of different ways. Gas, hot water, steam, and electricity are the four sources of heat, but in most molding plants either steam or electricity is used.

Gas Heating

In small plastic molding plants, gas is often used to advantage for the heating of dies. Individual gas-fired boilers, such as the one shown in Figure 1, are installed for each molding machine. If the presses are otherwise self-contained, then the gas heating system makes each press entirely independent of remote power. Gas-fired boilers of about five-hp. size will usually supply sufficient steam pressure to give the necessary heat at the press. The dies are provided with cored holes about 1½-inch in diameter into which are inserted



(Courtesy: Edwin L. Wiegand Co.)

Fig. 1. Open-flame type, gas-fired boiler used for mold heating.

the burners. These burners are placed at the bottom of the holes on the lower half of the mold, and along the top part of the holes on the upper half of the die. The amount of heat required is regulated by automatic temperature control valves placed in the feed line, and operating temperatures of 280-380° F. can be maintained readily. Because gas heating is neither as clean nor as effective as steam or electricity, very few gas installations are to be found among custom molders.

Hot Water Heating

Another rather uncommon method used for heating molds is the so-called super-therm system. This process consists of circulating high-pressure water through the channels of the molds. The fluid in circulation is kept under pressure, thus giving sufficient heat to the die to permit efficient molding. Water for this type of heating is drawn from the bottom of the boiler and pumped through the entire circuit. Installation of supertherm systems is more expensive than the more widely used steam systems, but has certain advantages: (1) the dies can be heated more rapidly and kept at a much more uniform temperature; (2) maintenance costs are reduced because of the absence of scale and corrosion in the boilers, pipes, and dies; (3) there is a decided economy in fuel consumption due to the increased thermal efficiency; and (4) the piping and fittings used are much smaller, and no traps or vents are required when water is the circulating fluid.

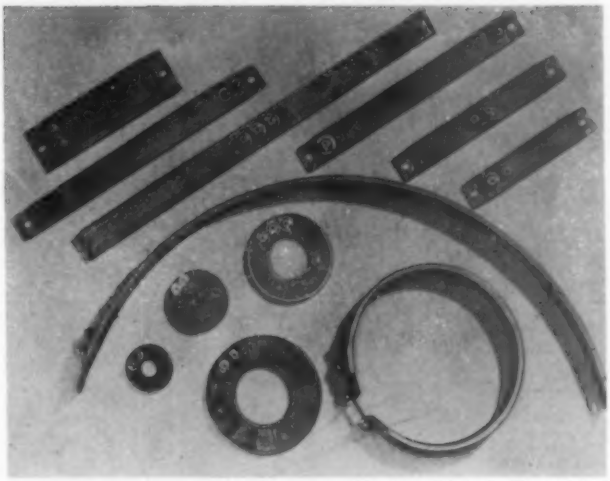
Steam Heating

Undoubtedly, steam is still the most widely used medium for the heating of compression molds. This method of providing heat is the oldest and, in many cases, the least expensive. All manufacturing plants must be equipped with a central source of heat to provide warmth during the winter months. Since a boiler must also be used to generate the steam that flows through compression molds, it is often possible for management to sufficiently increase the plant's boiler capacity to furnish the necessary thermal requirements for compression molding.

It is impossible to accurately determine the size of boiler or the amount of energy needed to give the required heat unless the design and sizes of the molds are known. For an average figure, though, it is fair to estimate that two hp. is sufficient for each press. In the heating of molds, the steam temperature bears a direct relationship to boiler pressure. Regulation of mold heat, therefore, is controlled by the use of pressure reducing valves at each press. Thus, the fluctuation in mold temperature can be held to a minimum.

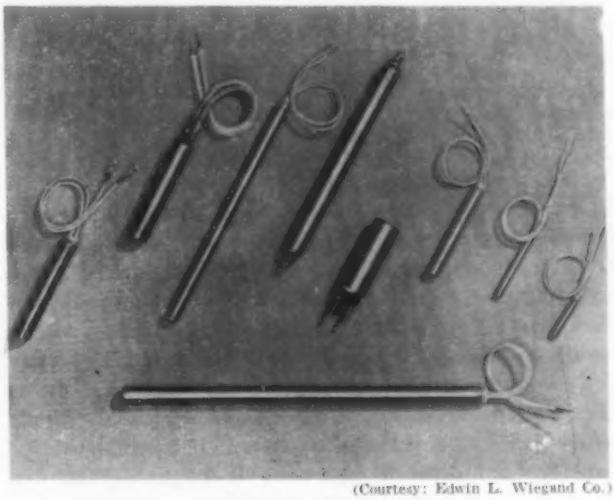
Electric Heating

Over the past few years, the use of electricity as a mold heating medium has gained much wider popularity. While steam is still used to a larger extent, electrical cartridges are replacing this method of heating in a number of instances. Basically, there are two types of electric heating elements now in use for compression molds, and their choice depends chiefly on the design of the dies. Flat strip heaters, such as those shown in



(Courtesy: Edwin L. Wiegand Co.)

Fig. 2. Flat strip-type electric heating units.

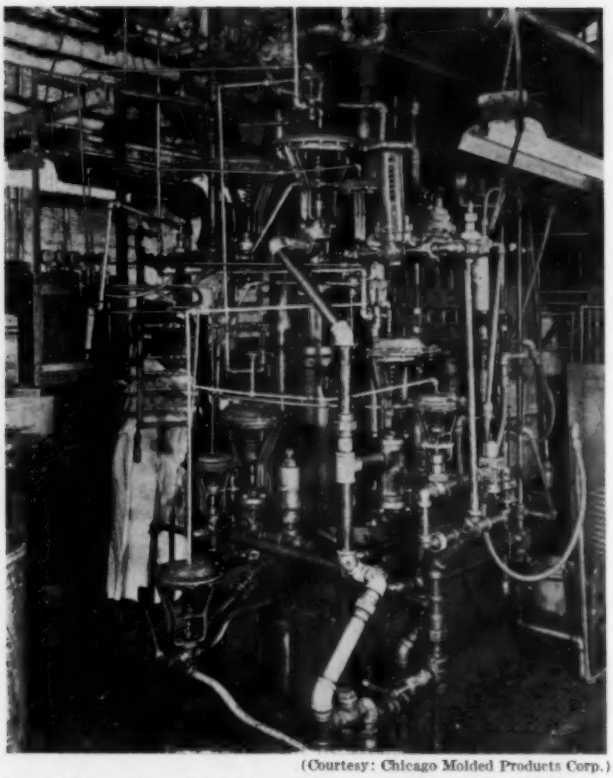


(Courtesy: Edwin L. Wiegand Co.)

Fig. 3. Cartridge-type electric heating units.

(Courtesy: Edwin L. Wiegand Co.)

Fig. 4. Compression mold in operation shows cartridge-type heating units inserted in mold halves.

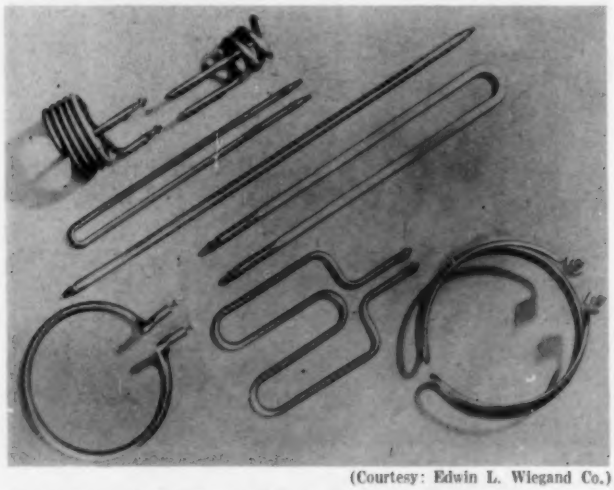


(Courtesy: Chicago Molded Products Corp.)

Fig. 5. Plant view of transfer molding press shows maze of piping required for steam heating of molds and pneumatic valve controls.

Figure 2, are installed when rectangular slots have been milled on the face of the mold. The cartridge type heating units illustrated in Figure 3 are inserted into cored holes. These round units are used more generally than the flat strips because of their greater ease of handling. Holes for the round type of cartridge are drilled in the upper and lower halves of the mold as may be seen in Figure 4. Hole sizes are usually made either ¾- or one-inch in diameter. The length of the cartridge conforms to the over-all length of the die, although a slight variation of ±½-inch is allowed.

Electrical units are available in a wide variety of wattages. The total heat required must be calculated as a function of the cubical contents of the mold. In order to compensate for radiation losses on the outer sections of the die, the cartridges of higher rating are placed in the outside holes. For instance, if the total wattage required amounts to 3,7 Kw and there are four holes in the die, the two outside units would probably have a 950-watt rating, while the inside cartridges would be rated at 900 watts. The cartridges themselves are constructed with a heat gradient so that they give off more heat at the ends than in the middle sections. Thus, a more uniform distribution of heat on the mold is made possible.



(Courtesy: Edwin L. Wiegand Co.)

Fig. 6. Formed tubular electric heating units.

Electrical cartridges are made with both terminals at one end of the units. Preparatory to operating the mold, the units are hooked together to make a complete circuit. In order to obtain the necessary heat regulation at desired temperatures, thermometer controllers are connected with the heating units. By means of 'on' and 'off' electrical relays, the heat of the dies can be kept within a close temperature range. On fully automatic set-ups, the molder has only to set the controllers at the desired temperature; once that heat has been reached, it will be maintained without the need of further attention. On compression molds, thermometer controls are placed on both the top and bottom parts of the die. This arrangement permits the use of any desired temperature differential between the two halves.

Steam vs. Electric Heating

One of the chief features of electric heating is its comparative cleanliness. With steam installations, many leaky joints will develop in the line to cause an undesirable condition. Steam requires the utilization of hundreds of feet of piping, since each press is supplied with both feed and take-away lines. With a maze of piping (see Figure 5) kept filled with live steam, the entire molding plant is subjected to radiated heat. This additional warmth is welcome during the cold months, but molding room conditions very often become unbearable during the summer.

As a general rule, molding temperatures exceeding 360° F. are not required, although some phenolics are now being molded at higher heats. When live steam is used for heating, medium boiler pressures must be maintained. To obtain a temperature of 360° F. at the mold, boiler pressure must be brought up to 140 psi. If it is desired to raise the molding temperature to about 385° F., the boiler will have to be pushed to a pressure of nearly 200 psi. This latter pressure approaches the limit of average boiler capacities. The temperature range of electric heating, however, is not limited at all, and any desired temperature value can be obtained by merely changing the thermostat controller. In addition, when electrical heating units are used, the top part of any die can be held at one temperature, while the bottom half of the mold can be maintained at another.

The use of electric heat for molds makes each press an independent unit, and only a power shut-down can cause complete cessation of molding operations. When steam is furnished from a boiler, any breakdown in the main line or in the boiler itself will immediately halt all molding activity in the press room. Since no fittings, joints, traps, and other expensive components are required in an electrical system, maintenance and replacement costs are reduced commensurably. On the

other hand, certain disadvantages are to be found in the electric cartridge method of heating molds.

Electrical energy is expensive, especially when kilowatts are converted into heat. From the standpoint of operating cost, then, the use of steam will often prove to be more economical than electricity. In the production of compression molded parts, the maintenance of constant temperatures during molding is very important and any wide variation in mold heats often leads to operational troubles. Steam heat permits close control over mold temperatures and, hence, molding conditions are not subject to wide fluctuation. Another point in favor of steam as a heating medium is the opportunity afforded the molder to alternately heat and cool the dies. In certain instances, the thermoplastics must be compression molded. When this method is employed, alternate flows of steam and cold water are injected into the channels of the die. Although this is recognized to be a slow process, this procedure can be accomplished only when steam or hot water is utilized as a heating medium.

Steam vs. Electric Heating

Summarizing, the two most widely used methods of heating compression molds can be compared as follows:

Electric Heating

Cooler operating conditions in the plant.
Greater cleanliness at the presses.
Higher temperatures available.
No obstructive piping required.
Lower maintenance expenses.
Fewer total shut-downs.

Steam Heating

Thermoplastics can be molded.
Less mold temperature fluctuation.
Heating costs may be lower.

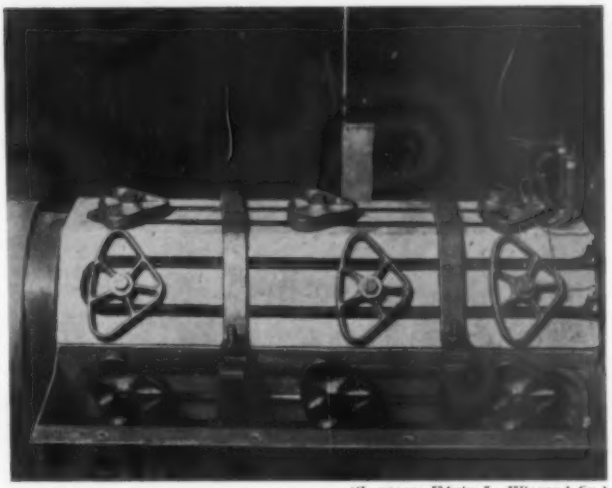
Much higher temperatures are required in the molding of thermoplastics and therefore, electricity is the chief heating medium. Where heats exceeding 400° F. are necessary, the use of steam is impractical. Injection molding requires temperatures within a general range of 350-600° F., and such heats are easily obtainable with cast-in or formed tubular electrical resistance units (see Figure 6).

Although extrusion machines often are heated by means of hot oil which circulates through the cylinder jacket, electricity is more generally used. Figure 7 illustrates an extrusion barrel that has been converted to electric heat. Today, nearly all injection molding machines have cylinders which utilize electric heater bands. These are usually grouped so as to permit independent temperature regulation at the front and rear of the cylinder. Most machines now are equipped with an additional band at the nozzle to prevent cold slug formation in this extremity.

Conclusions

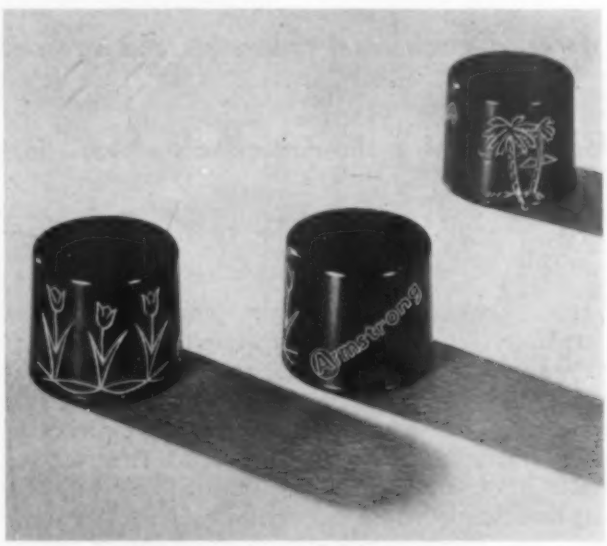
On the basis of the foregoing facts, it can readily be seen that the use of electricity as a heating medium is the most desirable in most instances. The advantages cited for the use of steam for compression molds are less applicable today than they were 20 years ago. Advances in injection molding techniques have practically eliminated the need for compression molding of thermoplastics. Furthermore, improvements in the sensitivity of thermostats have permitted better temperature control of electric cartridges. The only remaining advantage of steam as a heating medium is to be found in its possible lower cost. Even this factor is subject to question, and the comparative costs of heating media should be investigated very carefully.

—THE END



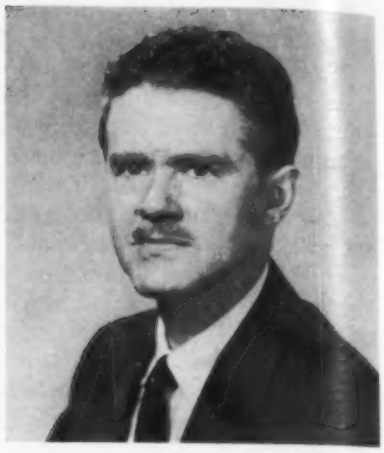
(Courtesy: Edwin L. Wiegand Co.)
Fig. 7. Extrusion barrel converted to electric heating by means of tubular heating units.

Debossed Cap Designs



Designs can be debossed on the skirts of plastic caps thanks to a new mold-making process developed by Armstrong Cork Co., Lancaster, Pa. An electroplating method, similar to that used in the manufacture of chrome parts or copper-bottom kitchenware, was perfected to produce molds with embossed designs along the walls. Color can be wiped into the etched parts to create striking effects.

—THE END



B. B. PUSEY, *Development Department, Bakelite Co., Bound Brook, N.J.*

Effect of Time, Temperature, and Environment on the Mechanical Properties of Glass-Reinforced Plastics*

Standard mechanical properties and stress-rupture strengths are reported for 14 laminates, showing effects of variations in resin, reinforcement, and finish.

DESIGN engineers have been presented with an abundance of standard (room temperature) mechanical properties with which to design plastic structural components. They have been obliged to apply large factors of safety to these standard mechanical properties in order to convert them to design strengths. However, the effects of time, temperature, and environment upon long-time strengths are not represented by short-time tests, and efforts to design using standard mechanical properties usually result in either failure of the components or use of excessive material. There are few data on reinforced plastics to which the design engineers can apply the concept of anticipated service life.

The purpose of this paper is to present some experience in the evaluation of low-pressure laminating resins for structural applications. Emphasis is placed upon one type of test which has proven to be very effective for evaluating resins (1)** reinforcements, and resin-reinforcement interface reagents. In this work, an attempt is made to integrate the factors of time, temperature, and environment upon the mechanical strengths of 14 reinforced plastic laminates described in Table 1. Conclusions are drawn concerning the relative merits of four general classes of thermosetting resins, two types of fibrous glass, reinforcements, and two resin-glass interface reagents. It is believed that data

*Based on a paper presented before the Reinforced Plastics Division, Society of the Plastics Industry, Inc., Atlantic City, N. J., Feb. 9, 1954.
** Numbers in parentheses refer to bibliography at end of article.

such as these will contribute to the effectiveness of design and stimulate the development of resins and reinforcements.

The Problem

The standard mechanical tests (tensile, flexural, etc.) evaluate the ability of a material to support a stress which is brought to a maximum in from 2-3 minutes in air at 23° C. Such tests are useful in providing an initial idea of the "strength" of a material. However, these tests do not reproduce many conditions of use, and may give a misleading estimate of structural strength. For example, a pipe conveying hot water under pressure is subjected to three factors which the standard tests do not reproduce; i.e., the action of the water, the elevated temperature, and the sustained nature of the stress.

Under prolonged dead-weight loading, many materials fracture or break when stressed at values considerably below their short-time strengths (1-6). Tests which are designed to bring out this phenomenon are known as stress-rupture tests (7). When such tests are applied to materials in the presence of water or other environments, failure may occur in a relatively short time, showing the effect of the environment upon the stressed material. Tests designed to evaluate the effect of environment on stressed material are called stress-corrosion-rupture tests (8).

An illustration of the relationship between the short-time and long-time flexural strengths of a laminate is shown in Figure 1. Under a constant straining rate (strain increasing linearly with time), the stress increases to 70,000 psi. in air or water before the material ruptures. However, if a constant stress of 45,000 psi. is applied, a specimen fails within 30 hours in air and within five hours in water. If the constant stress is reduced to 30,000 psi., a specimen fails at 900 hours in air and within 50 hours in water. The tests in air (stress-rupture) illustrate the dependence of strength upon time, while the tests in water (stress-corrosion-rupture) measure the strength as a function of time and environment.

Test Methods

The purpose of any mechanical laboratory evaluation is to predict the structural performance of a material from practical laboratory tests. Since short-time tests do not provide sufficient structural information, they must be accompanied by tests which are more effective. Stress-rupture and stress-corrosion-rupture tests are without doubt more effective in this regard, where the criterion of failure is rupture and applied stresses are essentially unvarying. The dotted curves of Figure 1 show the actual maximum stress-bearing capabilities of a laminate, in air and water, up to a service life of 1,000 hours.

To be effective, stress-rupture tests must be designed to extend over a period of time which is long enough to characterize materials. Tests which measure the stress-bearing capabilities up to 1,000 hours are frequently used in this regard, and the maximum stress which materials can support for 1,000 hours is used

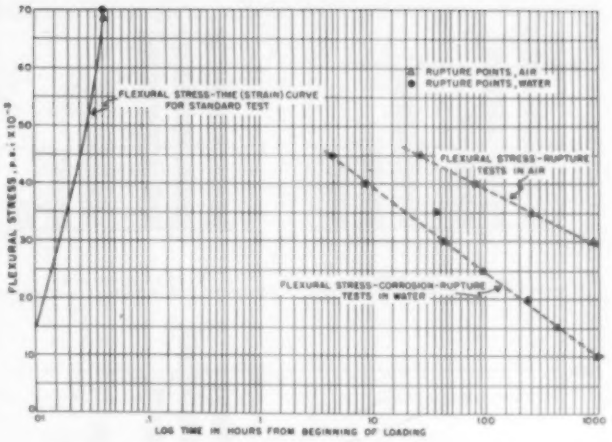

RUPTURE POINTS, AIR
RUPTURE POINTS, WATER
FLEXURAL STRESS-TIME (STRAIN) CURVE FOR STANDARD TEST
FLEXURAL STRESS-RUPTURE TESTS IN AIR
FLEXURAL STRESS-CORROSION-RUPTURE TESTS IN WATER
FLEXURAL STRESS, p.s.i. x 10⁻³
LOG TIME IN HOURS FROM BEGINNING OF LOADING

Fig. 1. Flexural stress vs. time to rupture at 140° F.

to compare the strengths of materials. Although most structures are designed to last more than 1,000 hours, it is not always economically possible to test materials longer than 1,000 hours. This test, therefore, gives information which represents a convenient level for comparing materials for structural strength.

The stress which a material can support for 1,000 hours cannot be measured directly by using only one specimen. Instead, a series of specimens must be tested over a range of stresses, beginning with one specimen tested at a relatively high stress, and following with specimens tested at successively lower stresses. The specimen tested at the highest stress fails in a relatively short time, while those specimens tested at lower stresses fail at longer periods of time. A running record of specimen failures is kept on four-cycle semi-log graph

Fig. 2. Flexural stress-corrosion-rupture test apparatus.

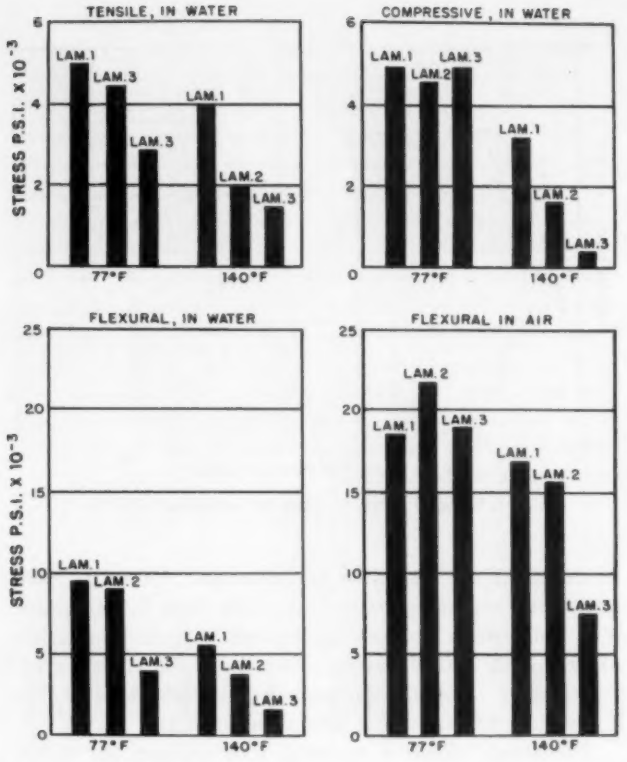


Fig. 3. 1,000-hour tensile, compressive, and flexured stresses of three polyester resins reinforced with T-19 glass mat.

paper which covers duration from 0.1-1,000 hours. Experimental points, entered on the graph as specimens fail, serve as a guide in selecting succeeding stresses to be applied. Finally, a curve is drawn through the experimental points, and its intersection with the 1,000-hour ordinate is taken as the 1,000-hour stress. Such a test, when performed in water, is called a stress-corrosion-rupture test.

Figure 2 shows the apparatus used to perform flexural stress-corrosion-rupture tests. A continuous span of 4.00 inches is provided near the bottom of the tank. Specimens are placed along the span at five-inch intervals, and the central loading edges are lowered to

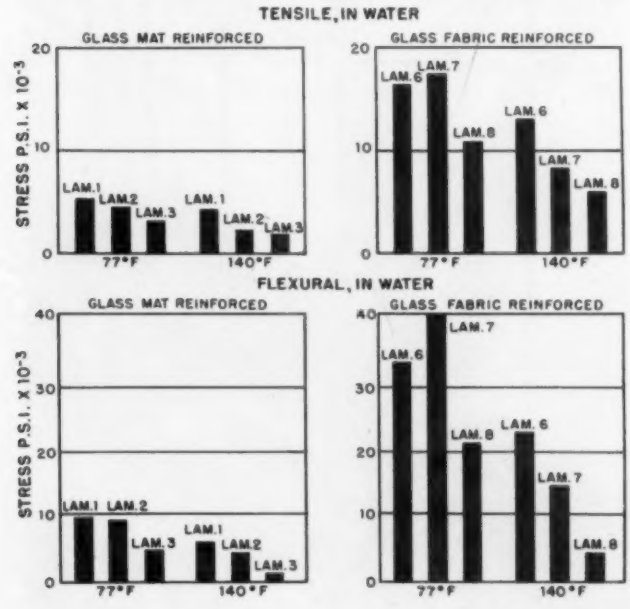


Fig. 4. 1,000-hour tensile and flexural stresses of polyester resins reinforced with glass mat and glass fabric.

rest upon the specimens. Finally, the slotted weights are added without shock, the switches are closed, and the timers are set to zero. When specimens rupture, the switches open and the times to failures are indicated on the timers. Flexural test specimens used in this work measure ⅛ x ½ x 6 inches in size, and are tested flatwise.

Tensile stress-corrosion-rupture tests were conducted with a four-position multi-tester which can be used for testing in air or in liquids at room or at elevated temperatures. Tensile test specimens were ½ inch wide for polyester-glass mat laminates, and ¼ inch wide for polyester-glass fabric laminates.

Compressive stress-rupture tests were conducted with the deformation testing machine of ASTM Method D621-51. The machine was modified to permit the application of unvarying compression stresses in air or in liquid environments at room or elevated temperatures. Test specimens measured ½ x ½ x ⅛ inch, and were loaded edgewise (parallel to direction of warp in laminate).

Test Results

Effect of Polyester Resin

The bar graphs of Figure 3 indicate the greatest stress which the materials can support for 1,000 hours in water or in air. They demonstrate the effects of temperature and a water environment on the structural strength of laminates made from three polyester resins reinforced with Owens-Corning T-19 glass mat (Laminates #1, #2, and #3 of Table 1).

The performance of the three laminates are summarized as follows:

(1) All laminates lose strength due to an increase in test temperature.

(2) The flexural strengths of all laminates are reduced by the presence of water.

(3) For overall applications, laminate No. 1 offers the higher strength.

(4) Laminate #3 is greatly weakened by elevated temperature and water.

(5) Laminates #1 and #2 would offer about the same strength in glass-mat reinforce structural elements for use at normal temperatures.

Effect of Reinforcement

The bar graphs of Figure 4, compare the strengths of polyester-glass mat laminates (#1, #2, and #3 of Table 1) with the strengths of polyester-glass fabric laminates (#6, #7, and #8). The glass mat used was Owens-Corning T-19 random mat, while the glass fabric used was Owens-Corning 181-136 fabric.

The data clearly indicate that polyesters reinforced with 181-136 fabric are stronger than polyesters reinforced with T-19 mat. In fact, the 1,000-hour strengths of the fabric-reinforced laminates are about four times the 1,000-hour strengths of the mat-reinforced laminates when tested in water either in tensile or in flexural stress.

The ratio of strengths of fabric-reinforced laminates to strengths of mat-reinforced laminates is 1.8:1, based upon standard mechanical tests and 1,000-hour stress-

Table 1. Laminates Evaluated for 1,000-Hour Strengths.
(All laminates nominally 1/8-inch thick).

Laminate Number	Resin Type	Reinforcement	Type of Interface Reagent
1	Polyester A	Owens-Corning T-19, 2-oz. glass mat	Chrome complex
2	" B	"	" "
3	" C	"	" "
4	" D	"	" "
5	" D	G.P. Garan 1½-oz. glass mat	Silane
6	" A	Owens-Corning 181-136 glass fabric	"
7	" B	"	"
8	" C	"	"
9	Epoxy	Owens-Corning 181-Volan A	Chrome complex
10	"	"	" "
11	"	"	" "
12	Phenolic	"	" "
13	"	"	" "
14	Silicone	181 glass fabric	Heat cleaned

rupture tests in air. Thus, it may be concluded that polyester laminates reinforced with Owens-Corning 181-136 fabric are less affected by the presence of water than are polyester laminates reinforced with Owens-Corning T-19 mat.

Effect of Various Resins

The 1,000-hour flexural strengths of nine laminates (#6-14 in Table 1) are shown in Figure 5 for tests made in water at 77 and 140° F. Polyester, epoxy, and phenolic laminates were reinforced with Owens-Corning 181-finished glass fabric, while the silicone laminate (#14) was reinforced with 181-heat cleaned glass fabric.

These graphs show the sensitivity of the stress-bearing capabilities to increasing water temperatures. The following comments summarize the graphs of Figure 5:

(1) The strengths of all laminates in water were significantly reduced by increasing test temperature.

(2) Of the polyesters, laminate #6 was least affected and lost only 34% of its strength due to the temperature increase.

(3) Of the epoxies, laminate #9 was least affected and lost only 35% of its strength due to the temperature increase.

(4) The phenolic which was least affected was laminate #12 which lost 45% of its strength.

(5) Laminate #14, bonded with silicone resin, appears relatively poor in the temperature range of 74-140° F. At more elevated temperatures, however, the silicone laminate would be expected to compare more favorably with other laminates.

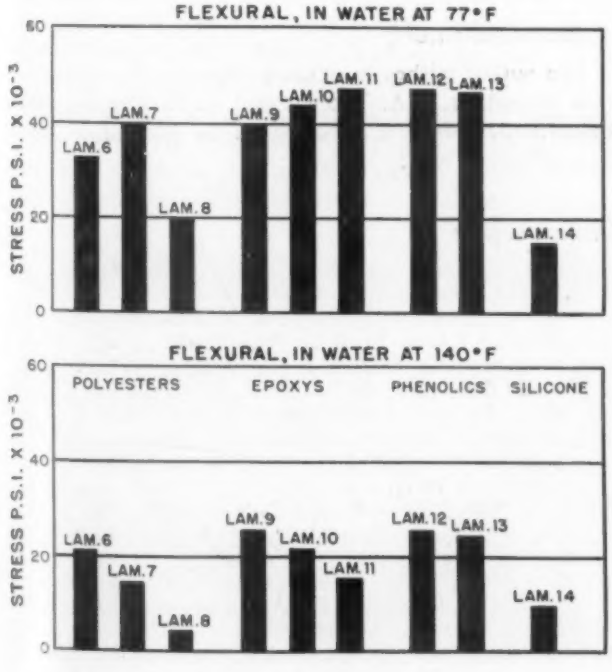


Fig. 5. 1,000-hour flexural stresses of various polyester, epoxy, phenolic, and silicone resins reinforced with 181 glass fabric.

Effect of Interface Reagents

A comparison of flexural strengths of two laminates tested at 77 and 140° F. is given in Figure 6. Although both laminates contain the same resin, one is reinforced

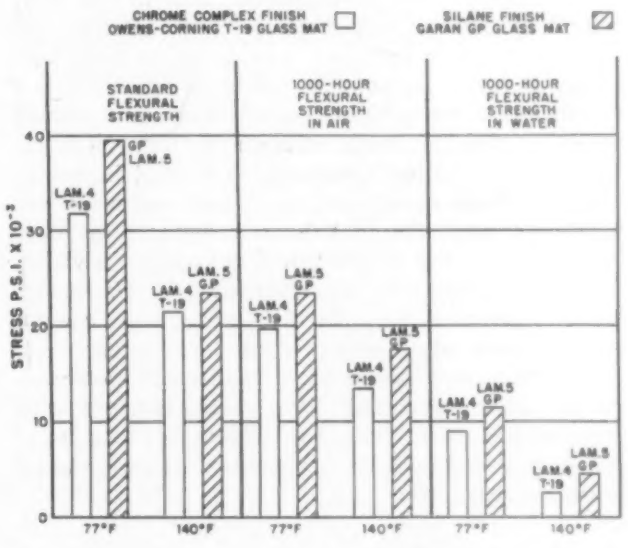


Fig. 6. Effect of glass finish on flexural strengths of various polyester-glass mat laminates.

Table 2. Conventional and 1,000-Hour Flexural Strengths for Glass Fabric-Reinforced Plastic Laminates.

Resin	Conventional Flexural Strengths in Air, Psi.		1,000-Hour Flexural Strengths in Water, Psi.	
	At 77° F.	At 140° F.	At 77° F.	At 140° F.
Polyester Laminates:				
#6	50,000	40,000	32,000	21,000
#7	61,000	41,500	40,000	14,000
#8	61,000	21,000	20,000	4,000
Epoxy Laminates:				
#9	63,600	59,800	40,000	26,000
#10	64,600	64,400	44,000	22,000
#11	74,200	70,100	47,000	16,000
Phenolic Laminates:				
#12	83,000	74,100	47,000	25,000
#13	76,500	72,400	47,000	24,000
Silicone Laminate:				
#14	31,400	22,200	15,000	9,700

with three plies of a chrome complex-finished mat (Owens-Corning T-19), and the other is reinforced with four plies of a silane-finished mat (Garan GP).

The finish is applied to a clean glass mat to improve the adhesion between the resin and the glass reinforcement. A good bond between resin and glass will result in a mechanically superior laminate. It is clear from Figure 6 that the silane-finished mat is superior to the chrome-finished mat although time, temperature, and environment greatly affect the stress-bearing capabilities of laminates reinforced with either type of mat.

For convenience, the important data for the nine glass fabric-reinforced plastics laminates is given in Table 2. This table permits a rapid comparison of the short-time and long-time properties, and also shows the effects of time, temperature, and environment. A similar comparison for two glass mat-reinforced laminates is found in Figure 6.

Edge Effects

Plastic laminates generally exhibit resin-rich, glossy surfaces. It is believed that these surfaces retard penetration of liquids from environments, and, in this way, protect structures from stress-corrosion failures. The specimens used in this work were prepared from laminates; therefore, edges were machined while the two surfaces were "as molded." The effect of the machined edges on flexural design strength in water was investigated by testing specimens ¼-1 inch in width. The 1,000-hour strength of the ¼-inch specimens was 9,700 psi., while the 1,000-hour strength of the one-inch specimens was 10,200 psi. This variation is within the panel-to-panel variation experienced in this testing. Several specimens were tested in water after coating the machined edges with a thick layer of stopcock grease. The results from these "protected" specimens did not differ significantly from results obtained with uncoated specimens. Thus, it is believed that data determined from this work are applicable to larger areas of laminated structures.

Conclusions

Short-time mechanical properties determined in air at room temperature are of limited value to the design engineer. The same properties determined over a temperature range, although of more value, are still of limited usefulness. Results from standard mechanical tests performed in corrosive environments do not necessarily measure the ability of a material to support sustained loading in the environments.

The flexural stress-corrosion-rupture test is an effective tool for evaluating a wide range of rigid plastics, reinforcements, and resin-reinforcement interface reagents for structural application. It has proved equally versatile in studying molding materials which have brittle stress-rupture characteristics.

Laminating resins, as well as reinforcements and interface reagents, differ significantly in structural performance. Plastic laminates of all types may be extremely useful if their properties are evaluated carefully and applied wisely to structural problems.

Acknowledgment

The author wishes to acknowledge the fine cooperation offered by P. A. Thomas and R. H. Carey of the Bakelite development laboratories in Bloomfield and Bound Brook, N. J.

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Chemical Blowing of Cellular PVC

(Continued from page 521)

It should be mentioned here that once foam has been produced, fusion in a radio-frequency (RF) dielectric field is most convenient and feasible, and results in a significant reduction in cycling time. Adoption of RF heating to carry out the initial foaming step has been tried but, to date, appears to be somewhat more difficult to control than the more conventional heating methods.

RF heating is considered necessary if foam thicknesses of three inches or more are to be fused successfully. Exposure time in the high-frequency field is only a small fraction of that required for conduction heating, and is governed by such factors as the frequency of the dielectric unit, the composition of the plastisol, the thickness and density of the foam, and the air gap between the foam and the top electrode.

Thin sheets of sponge, as shown in Figure 3, were obtained by slicing thicker slab stock. With the BL-353 chemical blowing process, however, vinyl foam may be produced in thicknesses of ⅛-⅜ inches following a single temperature heating operation which lends itself to production of supported or unsupported sponge on a continuous basis. Substrata such as fabric, paper, and lightweight fiber board have been given a foam coating by a casting, then heating procedure. In addition to the thickness of foam, the quantity of BL-353 employed influences the length of cycle which ranges from 3-15 minutes at temperatures from 365-410° F.

Making Molded Items

Chemical blowing is particularly well adapted to making expanded molded objects. By this means, pieces may be produced at a single temperature either with surface skin or skin especially prepared by a previous slush or rotational molding step. Open-cell vinyl foam so produced has good dimensional stability, and accurately reproduces the mold contours. Objects such as valve covers may be molded to close tolerances, since the shrinkage factor is small. Feather edges as well as irregular, complex shapes are obtainable.

Mold design, oven efficiency, uniformity of heat distribution, and distance of the mold from the heating elements influence the selection of the actual heating conditions. Arm rests, safety pads, and similar items

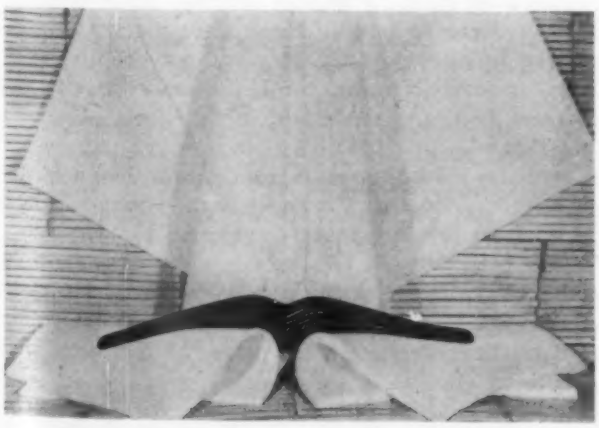

Fig. 3. Thin sheets of sponge obtained by slicing thicker slab stock. (Courtesy Crest Chemical Industries).

Fig. 4. Mold for expanded molded article has loose-fitting cover.

may be produced in 20-30 minutes at 350-425° F. after the expansible plastisol is added. Larger pieces with thicker cross sections, such as toy ducks and dolls, require slightly longer oven heating.

In preparing expanded molded articles, a predetermined amount of plastisol representing 15-50% of the mold volume is added to the cavity. The exact quantity of plastisol used is governed by the degree of expansion desired, hence the quantity of BL-353 employed. Suitable vents must be strategically located around the mold or the mold cover must be loose fitting (see Figure 4) in order that displaced air may escape and excess plastisol may overflow. The plastisol may be poured into the mold either directly or on top of a previously gelled vinyl skin. The mold is assembled and the unit placed in the heating chamber for an appropriate length of time during which the plastisol expands and then fuses. After cooling, the mold is separated and the completed product removed.

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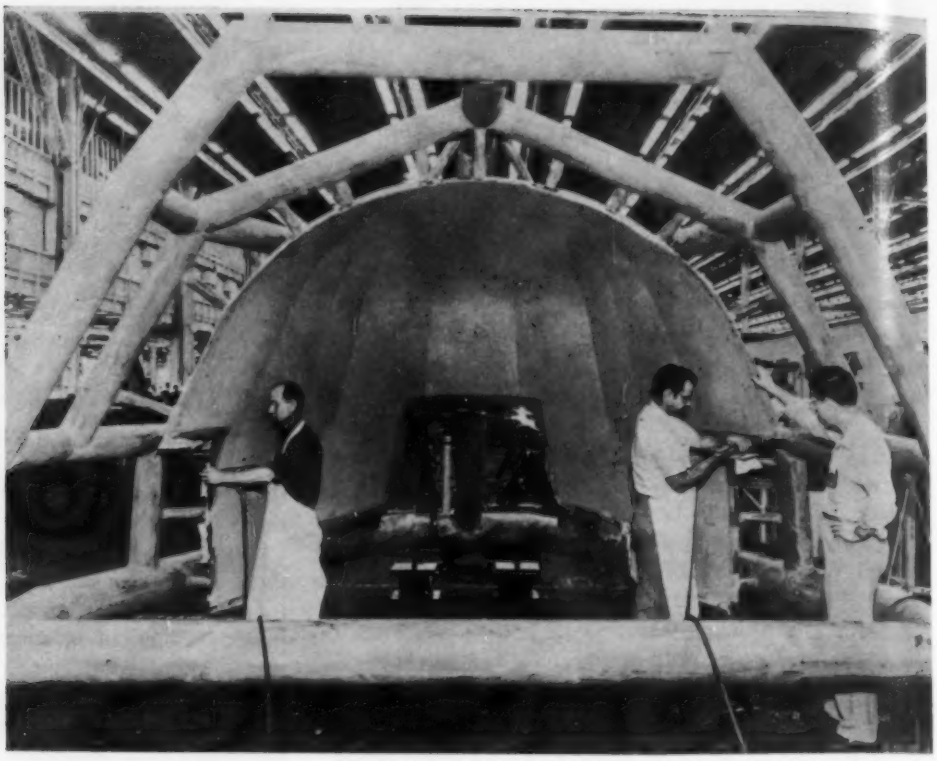

Fig. 1. Master gage of epoxy-glass laminate is used to check alignment of the Hercules' whole upper front window area.

Transport Plane Made with Plastic Tools

THE Hercules C-130, the first U. S. turbo-prop transport plane to reach production, is being made with plastic tools to achieve significant savings in time and cost. Plastic trim jigs, checking fixtures, and other tools being used by the Georgia Division of Lockheed Aircraft Corp., Marietta, Ga., to produce the new transport are light and accurate glass-reinforced laminates made with liquid compounds based on Bakelite epoxy resins.

The relatively short aircraft production runs, cut even shorter by frequent design changes, make jigs, dies, tools, and fixtures costly items to amortize. To help reduce these costs, Toolplastik epoxy compounds made by Rezolin, Inc., Los Angeles, Calif., are being used to produce tools in less time and with the high degree of accuracy required for forming and assembling aircraft parts.

Lockheed uses thousands of plastic tools to make C-130, with each plastic tool representing a saving of from a dozen to several thousand man-hours of tool-making time. Nearly 50,000 parts, not counting nuts, bolts, and rivets, go into the C-130, and about 10,000 of these parts are made with plastic tools, dies, jigs, and fixtures.

Probably the largest plastic tool ever made is a master gage for checking the alignment of the Hercules' whole upper front window area (see Figure 1). The entire 95 feet of fuselage is pressurized, which calls for tight and accurate fitting of the fuselage sections. The shell of the gage is an epoxy-glass laminate, and the frame of normalized steel is 18 feet wide, 14 feet deep, and nine feet high.

Another plastic tool is a device for setting the ailerons, and consists of a plywood frame reinforced

(*Continued on page 537*)

Epoxy Pastes Prove Versatile

Properties of the resin pastes are discussed, with particular attention to their usefulness in varied industrial applications.

JOHN DELMONTE, *President*
Furane Plastics, Inc.,
Los Angeles, Calif.

Epoxy resins formulated into paste-like consistencies are experiencing extensive utilization in many fields. Strong, non-shrinking, and tightly adhering, they not only fulfill repair functions and patching measures, but also serve per se as materials for the design of various products.

Pastes which are able to set chemically upon the addition of appropriate hardeners are derived from liquid thermosetting resins, such as phenolics, furanes, polyesters, and epoxies. The first three types are limited in their choice of fillers (some of which are adversely affected by hardeners) and by a significant amount of of shrinkage. The epoxies alone possess the versatility of combining with a wide assortment of fillers; setting with a minimum of shrinkage; and at the same time excellent adhesion.

Basic to the formulation of any paste is the change of viscosity with filler composition. Figure 1 records the viscosities at 80° F. for an Epocast resin filled with lightweight (colloidal) silica, an aluminum oxide and aluminum. Thixotropic mixtures require comparisons to be predicated upon uniform spindle size and speed during measurements. As the readings begin to rapidly exceed the viscosity value of 100 poises, paste-like formulations are approached.

Whether an epoxy paste should be prepared from a lightweight silica or a heavier steel-filled compound depends upon the functions to be accomplished. The more heavily filled pastes will have a much lower peak exotherm than those which are more lightly filled. On the other hand, better wetting-out qualities appear to be the province of the less dense mixtures.

In order to illustrate typical epoxy pastes, Table 1 lists the members of the Epocast 150 Series and compares their salient physical properties. Particular attention should be given to flexural strength and thermal coefficients of expansion (which match metal in heavily filled types). Most of the types listed will cure at room

Table 1. Physical Properties of Epocast 150 Series Epoxy Resin Pastes. (Cured 24 Hrs. at Room Temp., Post-cured One Hr. at 200° F.).

Epocast	Specific Gravity at 80° F.	Shrinkage, In./In.	Tensile Strength, Psi.	Compression Psi.	Gel Time of 100 Gr. at 75° F., Min.	Lap Shear, Psi.	Coefficient of Linear Expansion, x 10^{-5} At 40-70° F.	At 70-120° F.
150	1.19	0.00069	6,000	17,000	17	1500	3.4	3.3
151	1.58	0.00112	6,000	18,000	18	2400	2.1	2.2
152	1.24	0.00098	3,500	8,500	41	2000	3.0	3.4
153	1.19	0.00127	4,900	9,300	69	2800	5.8	6.3
154	2.76	0.00061	5,300	16,700	64	2600	2.4	2.5
155	1.58	0.00160	6,000	16,700	240-300	2600	2.3	2.1
156	1.63	0.00084	5,200	18,000	25	2600	2.3	2.4

temperature, the advantage of longer pot life can be reaped if some heat cure can be applied.

Paste-like hardeners are also to be recommended for addition to epoxy pastes. The chemical nature of the hardener varies; polyamines, adducts from these polyamines, and some polyamides cross-link the epoxy materials into strong, useful products. Functionally hardeners for epoxy pastes may be classified into the following three curing system types:

(1) Room-temperature curing; short pot-life of 20-40 minutes; forming hard, rigid compounds which may be machined readily.

(2) Intermediate temperature curing; pot-life of 2-4 hours; flexible systems are available; strong, hard, readily machined materials are formed.

(3) Single component; high-temperature cure systems which remain paste-like until cured.

Systems 1 and 2 entail two components; paste and hardener. While pre-measured packages are the vogue

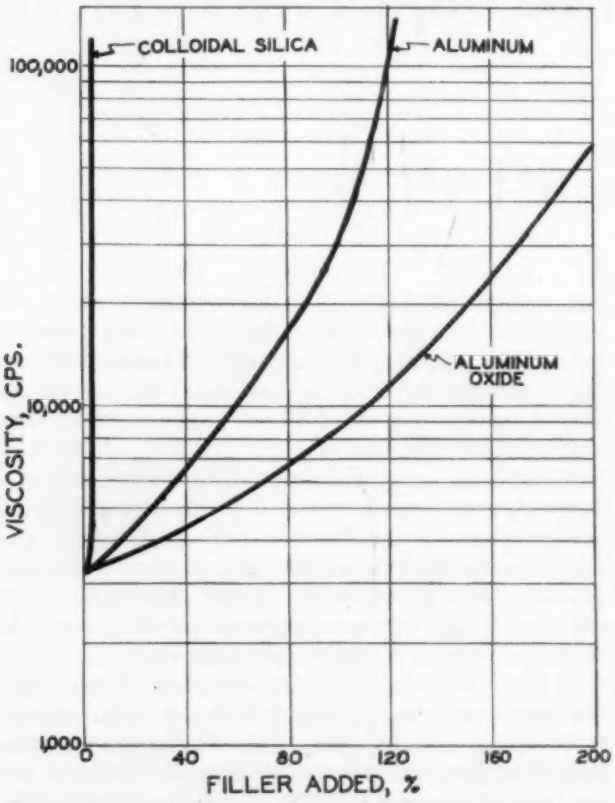

Fig. 1. Effect of filler type and quantity on viscosity of Epocast 2 epoxy resin.

in many production applications of epoxy pastes, other measures have been recommended for equal success. Some establishments are averse to weighing, and find surcease in the simple expedient of squeezing both hardener and resin from tubes and measuring the length of adjoining strips before blending together.

Industrial Applications

There are many useful industrial applications now developing for the epoxy pastes. Rather than classify the myriad existing types of applications according to mechanical, electrical, or chemical functionality, we can examine some of the interesting end-uses.

BODY REPAIR SOLDERS. Cutting an active swath through the automotive field, body repair pastes and plastic solders are attracting much interest. Pastes that will not run or sag; which will hold reinforcing glass cloth in place; which offer a metallic-like appearance; and which will not vibrate from the sheet metal body undergoing repair are being utilized.

In many instances, long pot-life epoxy pastes are preferred, heat-cure being effected with an infra-red lamp or a blow-torch applied lightly. Too rapid a heat-cure mitigates against a strong bond, so some moderation is urged. Furthermore, a certain degree of flexibility, obtained through Thiokol polysulfide) or polyamide modification of the epoxy, appears desirable.

A further safety precaution is warranted. Because many of the automobile body solders will be going into the hands of inexperienced, non-chemical individuals, the selection of relatively non-toxic hardener systems is most desirable.

The finished results are interesting, and torn metal automobile fenders are repaired without costly replacement by new body parts. In general, the glass cloth-reinforced area will outlive the metal because it will not rust nor be damaged as readily by bumping. Patching and filling of previously drilled holes in the automobile body are also accomplished by epoxy pastes.

CLAY PIPE JUNCTIONS. Figure 2 illustrates a typical successful application of an epoxy paste, Epibond 104, to join the halves of large sewer pipe fittings. Not only is the bond stronger than the material being joined, but also the chemically impervious, non-porous qualities of the epoxy resin are most attractive. Installations of this

Fig. 2. Halves of large sewer pipe fittings are joined at centers by Epocast epoxy paste.

character appear in chemical plants and sewer pipes, coping with many acids, alkalies and solvents. It is obvious that a non-flowing, thermosetting paste is required to be serviceable during installation.

CERAMIC TILE CEMENTS. The adhesion of Epocast resins to ceramic tile is phenomenal, and tile setters for both wet exposures and decorative exteriors will find outstanding performance in these pastes. After activation by hardeners, the pastes are usually spread over a base of concrete or plywood and the tile positioned. Excess epoxy paste will squeeze through the junction lines of the tiling, and tight bonds which will not wash out are established. These resin bonds are far superior to the gypsum previously used for this purpose.

Considerable hope is entertained for setting chemical-resistant tiles or bricks in the chemical industry by epoxy pastes. Although Furane resin cements are doing well in these areas, epoxy formulations will prove even more versatile.

WIPE-ON PASTES FOR SEALING. Quick setting pastes such as Epocast 155 are being used to fill imperfections in polyester and epoxy laminates. The technique involved is relatively simple. The paste and hardener system is mixed and spread across the large sanded area by means of a squeegee or spatula. Holes and openings are completely filled. After the material has set, additional light sanding to remove any high spots leaves a perfect, void-free surface. Large aircraft radomes are being finished in this manner every day.

SEALING ELECTRICAL UNITS. Epoxy paste-like formulations, such as H-591-B electrical grade, are employed as dip coatings for electrical units (see Figure 3). The rapid build-up of thick epoxy coatings effectively seals these units against moisture and atmospheric variations. Dipping operations of this nature can be conducted efficiently on an assembly-line basis. Epoxy resins afford the requisite electrical properties with good mechanical bond.

STEEL AND ALUMINUM FILLED PASTES. Epocast 152 and 154, the steel-filled and aluminum-filled materials have already received much attention in the machine tool

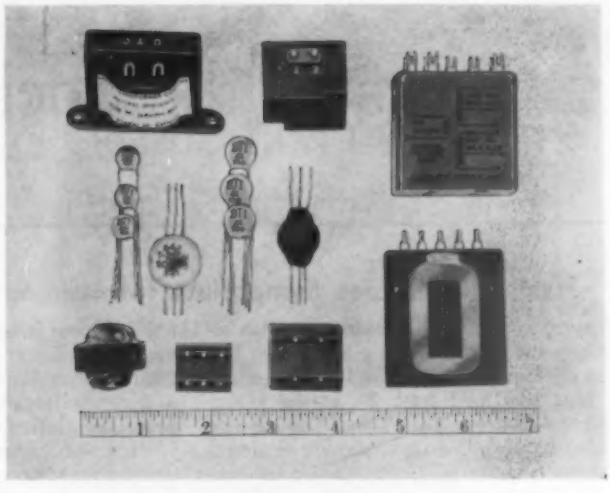

Fig. 3. Electrical components are dipped in epoxy resin pastes to seal against moisture and atmospheric changes.

field. Heavily loaded with metal fillers, they not only resemble metals in appearance, but achieve distinction in preparing holding fixtures, jigs, patterns, and duplicating devices. Epoxy resins and hardeners are not affected by metal powders, and considerable interest has been evinced in these combinations which bring out many of the fine qualities of epoxy plastics and metals.

The number of pastes and their applications are innumerable, but it is hoped that this article will awaken attention to the new and promising virtues of epoxy pastes.

—THE END

Transport Plane Made with Plastic Tools

(Continued from page 534)

Fig. 2. Laminated tool used to join tail or wings to fuselage.

with epoxy-glass cloth laminates and having an epoxy coating for weather protection. Snow-plow shaped tools (see Figure 2) are used to join tails and wings to the fuselage. For these tools, 10 or 12 layers of glass cloth are bonded with Toolplastik compounds to form a laminate about ⅜-inch thick. In the jig shop, rough edges are filed off and drill holes are spotted to exact dimensions.

Other plastic tooling includes plastic cribs for small tools; A-frames for carrying raw materials, work orders, and plastic checking fixtures to the drop hammer for fabrication; plastic jigs for drilling operations; forming dies; and a wide range of trim fixtures.

—THE END

News of the Societies

Plastics Structures Symposium for Building and Industry

A symposium on plastic structures, sponsored by the Thermoplastic Structures Division of The Society of the Plastics Industry, Inc., was held June 26, at the Hotel Roosevelt in New York City. The all-day meeting consisted of two morning sessions, a luncheon, and a single afternoon session, all devoted to present and future applications of plastics in building. Abstracts of the talks follow:

Fabricators' Panel

Joseph L. Huscher, Kaykor Industries, Inc., presided over this session, at which industry members spoke on design, engineering, and fabrication. Materials under consideration were PVC, polyethylene, and fluorocarbon sheets.

"Rigid, Unplasticized PVC as a Structural Material," George A. Gabriel, Atlas Minerals Products Co. Not only does the material have good chemical and physical properties, but it can be formed to any shape through standard fabrication methods. Six mechanical properties were considered: strength, which varies with the operating temperature; strain, which depends on the duration of stress; notch sensitivity; and expansion seven times that of steel; the necessity for pre-heating the sheet to relieve stresses set up in calendering; and the elastic "memory".

"Welding of PVC," Paul K. Chamberlin, Industrial Plastic Fabricators, Inc. Earlier techniques featured gas welding with an open flame; however, electrical welding torches are used today. The method described uses temperatures of 500-525° F., and an air pressure of 8-10 pounds. A 45° nozzle with a 5/32-inch diameter opening was employed. The rod should be held at right angles to the plane of weld, being very careful to maintain the proper distance to prevent overheating.

Papers presented at this session by William B. Meyer, St. Louis Metallizing Co., and A. N. T. St. John, Resistoflex Corp., were not available for abstracting.

Industrial Users' Panel

This session featured an appraisal of thermoplastic materials and equipment with respect to performance. Joseph L. Huscher, Kaykor Industries, Inc., again presided.

"Experience of Avisco with Thermoplastic Structures," L. B. Cundiff, American Viscose Corp. The firm's most successful applications involved polyethylene weldments (a float gage for sulfuric acid), fluorocarbon linings for xanthane churns, and piping installations. Polyethylene pipe presented difficulties due to its high coefficient of expansion, and its need for continuous support. Rigid PVC sheets were found to warp and delaminate at temperatures above 70° C., and the fluorocarbon linings often contained pin holes. The following suggestions for eliminating these difficulties were proposed: the need for a material with higher temperature resistance; a standard test for heat stability; and a means for avoiding pin holes in fluorocarbons.

"The Use of Plastics in the Duct System of the New Winston-Salem Plant," Edward St. Amand, Western Electric Co. The duct system for the electroplating exhaust carries 180,000 cubic feet of air per minute. More than 50% of the system is made up of unplasticized PVC, and includes such parts as the air-intake nozzles, the lateral connecting ductwork units, the overload ducts and risers, the pre-scrubber plant unit, fume hoods and scrubbers, post scrubbers, and gaskets. Other parts are principally steel with a PVC plastisol coating.

"Experiences with PVC," Charles Freeman, Scintilla-Magneto division of Bendix Aviation Corp. About 90% of the plating equipment used is Type 2 unplasticized PVC, including the exhaust system, baskets and trays, drainage trenches, and sinks. The material was reportedly superior to metal, and rubber-lined tanks were found to corrode on the outside. The only problem was felt to be that of temperature limitations.

"Plastics as Used at Eastman Kodak," E. E. Mohr, Eastman Kodak Co. Fluorocarbons and polyethylene have not been used at Eastman due to cost and temperature considerations; however, rigid PVC has been employed extensively for lined tanks, scrubbers, hoods, and mist eliminators. Both PVC Types 1 and 2 have been used, the latter being easier to fabricate. Rigid PVC was chosen principally for its chemical resistance, and is thought to fill the gap between stainless steel and the more expensive metals. The useful limits of the material cannot be determined without failures and, since this is not desired in operation, Eastman would like to see workable standards established. The firm feels that PVC's potential will be realized in direct proportion to the cooperation between producers and users.

Following luncheon, Hiram McCann, "Modern Plastics," discussed the "Potential for Structural Plastics."

Applications for Building

Willard Crater, Naugatuck Chemical division of U. S. Rubber Co. (now with W. R. Grace & Co.) presided over the afternoon session on **"Present and Future Applications for Building."** I. V. Wilson, Monsanto Chemical Co., served as moderator.

"Factors Which Limit Acceptance of Plastics in Building Structures," John Parkinson, Johns-Manville Sales Corp. Although Johns-Manville has many plastics applications under research, actual production is limited to vinyl asbestos floor tile. The firm feels that the high cost of plastics as structural materials permit them to be saleable only in terms of quality advantages. Standards and durability data are also desired, particularly in conformance to the building codes.

"Structural Plastics in Building," Albert G. Dietz, Massachusetts Institute of Technology. Four essential trends were noted: the increased use of shop-fabricated units for quick assembly; maximum flexibility in the use of space and a minimum of interior supports and fixed partitions; open, daylight-admitting walls; and an increased proportion of the cost of construction to mechanical equipment. The latter would include such items as air conditioning and luminous ceilings.

"Five Structural Panels Involving Plastics and Plastic Adhesives," Robert Hildebran, U. S. Plywood Corp. The growth of the plywood industry is reportedly due, in part, to resinous adhesives and plastics. Five noteworthy applications were listed as follows: Westinghouse's Micarta—a high pressure decorative laminate used as the integral facing of structural planels; Micarta-faced, resin - impregnated paper honey-comb cores; Kalestron, made by fusing a colored lacquer to the underside of a clear vinyl sheet and backed with cotton flock; Duraply, a thermosetting resin-impregnated cellulose fiber sheet; and Novoply, a reinforced plastic sandwich board made by fusing resin-impregnated wood flakes under heat and pressure.

"Possibilities for Plastics in the Building Materials Field," J. J. Allegretti, Masonite Corp. Since Masonite can be thought of as a ligno-cellulose plastic, there is a certain correlation between its introduction into the building field and plastics. The problem is essentially one of publicity and supply. The important considerations are the somewhat antiquated building code, the architect, the contractor, and the sales force. Limitations should be imposed only by imagination and design.

"Methods for Introducing a Structural Material," William H. Scheick, Building Research Institute. The first obstacle to introducing a new structural material is

(Continued on page 540)

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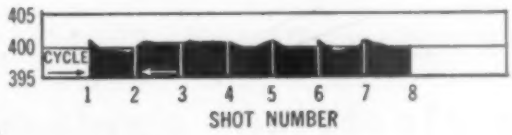
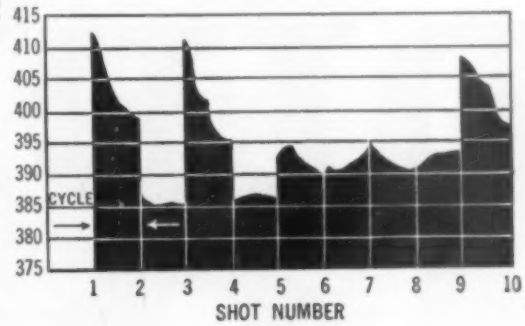


TEMPERATURE, °F

Mean Temperature 400°F
Non Uniform Granulation



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News of the Societies (Cont'd. from p 538)

one of economics. How costly is the material? Is it prohibitive? Assuming the material cost is within reason, the introduction problem is not too serious since we are in the middle of a rapidly growing building market. Only when the material makes appreciable inroads upon the sales of an existing material is there strong competition. To be saleable, the materials should have as few parts as possible, ease of assembly, and a minimum of maintenance problems.

Papers presented by Vincent G. Kling, Architect, and Donald J. Scholz, Scholz Homes, Inc., were not available for abstracting.

SPE Southern Section

SPE's Southern Section terminated its activities until fall with a dinner meeting at Mammy's Shanty, Atlanta, Ga., on June 19. Dick Hardesty, E. I. du Pont de Nemours & Co., Inc., addressed the group on "The Importance of Molecular Structure Specifications in Selecting Polyethylene."

Melt index, density, and molecular weight distribution are three factors which affect the processing and end-use performance characteristics of the polyethylene molecule. The third-mentioned factor is the least understood, but seems to indicate the frequency of the weaker links in the chain.

An increase in density results in stiffness, greater yield strength, higher softening temperature, and better resistance to creep. Melt index is a measure of flow of the molten polymer, and is an indicator of the ease of fabrication.

The range of molecular weight distribution for common commercial polyethylene is 3-60, with the narrow range being at the bottom of the scale. Narrowing distribution, or increasing uniformity of molecule size, results in higher tensile strength, resistance to stress cracking, and ease of processing at high shear stresses.

A sound-movie on the "Polyliner," an injection molding machine cylinder developed by Du Pont, also was shown.

Plan West Coast Conference

On August 22 the Pacific Coast Section of The Society of the Plastics Industry, Inc., will meet in Los Angeles, Calif., to formulate plans for the 1957 annual National Conference and Trade Exposition. For some time the Pacific Coast Section has been desirous of acting as host, and to acquaint the Society with the tremendous growth of the aircraft, construction, electronic, packaging, and the plastics industry in general on the West Coast. Following the meeting, more information will be announced as to the exact plans.

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(Continued from page 503)

Polyurethane Foam Load Deflection

"Studies with the flexible polyurethane foams have shown that with the polyester type the indentation load deflection is high while the density is low. It can then be concluded that the same load carrying capacity can be obtained with less material than usual. This would mean a saving in weight and volume of material used.

"A study of the stress-strain curve of compression shows that the stress increases very rapidly with strain initially, but then increases very slowly before beginning to increase rapidly again at a point near 50% deflection. If the procedure is repeated, it is noted that the second cycle curve lies considerably below the first, indicating some sort of compression decay. After four or five cycles, there is only slight change, if any, from one cycle to the next. If the foam is then permitted to remain at rest for several hours, the stress-strain values have returned to their initial state.

"If a polyester urethane is flexed to a point of 50% deflection for several thousand cycles at slow speeds, or if we flex it only 5% for several thousand cycles at high speeds, we find that the indentation load deflection value has decreased by as much as 20% or even 50% or more. This does not recover on standing."

I. N. Einhorn, Product Research Division
The Budd Co., Philadelphia, Pa.

• • •

NEWS of the INDUSTRY

Two Expansions for Du Pont

Expansions in production facilities for methyl methacrylate monomer and in coating facilities for Mylar polyester films have been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. The expansion of production facilities for the monomer, the raw material for acrylic resin products, is under way at the company's Belle Works, near Charleston, W. Va. Expected to be completed in about two years, the expansion will double Du Pont's capacity for manufacturing methyl methacrylates.

Coated Mylar is available only in experimental quantities for developmental purposes. Coating facilities to permit wider application in packaging and industrial applications will be installed at the company's Circleville, O., plant. Construction will start in September, and the coating equipment is expected to be ready for operation in the late summer of 1957. Coating makes Mylar heat-sealable on standard packaging equipment. In addition, improved impermeability to moisture can be imparted by coatings.

Enters Reinforcing Field

The glass fiber manufacturing operations of Famco, Inc., Louisville, Ky., are being extended to include production of reinforcing mat, surfacing, and decorative mat. A 60% increase last year in the company's plant faciilties will be devoted exclusively to the production of glass fiber reinforcements for the plastics industry.

All products are manufactured of continuous fibers, mechanically inter-woven and bonded with various resins. The decorative mat is supplied with a starch binder; is available with striking designs woven into the mat iself; and is used extensively in the tower coating process and for making decorative laminates. The reinforcing mat, with its high degree of uniformity, is widely used in making many items, including corrugated panels, luggage, light diffusers, and tote boxes. Famco surfacing mat is white, uniform, wrinkle-free, and easy to work.

New Expansion for Glastic

The floor space and manufacturing facilities of the Glastic Corp., Cleveland, O., are being enlarged by approximately 50% to accommodate the increasing demand for the firm's glass-reinforced plastic electrical insulating materials. This addition is the third major expansion in the company's 10-year history. Production was started in the present building last August.

Vinyl Light-Stabilizing System

A new light-stabilizing system for vinyl, employing four different stabilizing compounds, has been developed by Monsanto Chemical Co.'s organic chemicals division. Reportedly capable of withstanding 5,600 hours of accelerated artificial weathering before failure, the system offers three times the outdoor durability previously obtainable in vinyl compounds.

Monsanto has made patent application on the system, which employs only commercially-available components. Formulation is presented as follows: 100 parts vinyl resin; 47 parts plasticizer; two parts of a barium-cadmium stabilizer, three parts of an epoxide plasticizer such as epoxy triglyceride; 0.1-0.75 of an antioxidant (chelating agent); and 0.1-2 parts of an organic additive, constituency unannounced. The formulation will be made available to processors at no charge through Monsanto's technical service department.

Indoor accelerated testing was done on an Atlas fadeometer using transparent, plasticized formulations of Opalon 300 in a 40-mil thickness. Control samples showed light stability for 1,000-1,700 hours. Test samples prepared by the new system had a stability range of 3,600-5,600 hours. Higher figures in both cases were obtained with the more light-stable compounds. Outdoor tests being conducted at the Creve Coeur laboratories are said to be revealing substantially the same results.

Vacuum Metallizers Associate

A new trade association, Vacuum Metallizers Association, was formed by domestic manufacturers engaged in the metal coating of plastic films by vacuum processes during their visit to the Seventh National Plastics Exposition on June 11-15. The membership includes the leading 10 commercial manufacturers of metallized plastic films, and the officers are as follows: president, Milton Hammer, National Metallizing Corp.; vice president, John Hastings, Hastings & Co.; secretary, Clark Taylor, Metallized Products Co.; and treasurer, Heber Allen, Dobeckmunn Co.

The program of the new Association includes the promotion of standardization and simplification of products; the collection and dissemination of statistics and other information relating to metallized plastic films; the advancement of fair trade practices; the distribution of general commercial, economic, and government information relating to vacuum metallizing; and the presentation of the industry's views to other organizations, the government, and the public.

Car interior shows reinforced plastic paneling and bucket seats.

Reinforced Plastics Permit Halving Railway Car Weight

Extensive use of reinforced plastics has resulted in tremendous weight savings in the Pioneer III, a new railway coach designed and built by Budd Co., Philadelphia, Pa. Intended for commuter service and middle distance runs, the unit meets all AAR and ICC strength and safety requirements.

The car has less than half the weight of a standard model, 52,330 pounds as opposed to 125,700. In addition to laminated fiberglass-reinforced polyester panels and air ducts, numerous other plastic applications have been added. At each bay, a single reinforced plastic panel extends from the heater guard to include window trim and the lower portion of the baggage rack. A single, molded piece forms the double seat unit, which is covered by vinyl foam upholstery.

The lavatory is formed as a one-piece unit by the hand lay-up method. The entire assembly, including the outer wall lining is mounted into the car, prepiped and prewired. Reinforced plastic car exterior components include steps, car skirts, and battery boxes. The space above the corrugated floor sheathing and below the plywood floor is filled with isocyanate foam, generated in place.

Reportedly quiet-running and easy to maintain, the car is also economical to operate. It can be hauled by any standard tractive unit, and any mechanical part can be replaced in an hour. Test coaches have seen over 3,000 miles of service in experimental runs throughout New Jersey.

Two Chemical Firms Win 1956 Lammot DuPont Safety Awards

Pittsburgh Coke & Chemical Co., and Oronite Chemical Co., were presented with the Lammot DuPont Safety Awards at the annual meeting of the Manufacturing Chemists' Association, held at White Sulphur Springs, W. Va., on June 7. The awards are made annually to the chemical companies showing the greatest improvement in plant safety over a five-year period.

Pittsburgh was the winner in the two-million man hours category, while Oronite won among firms whose workers put in less than two-million man hours annually. Runners-up were Stauffer Chemical Co., and Heyden Chemical Corp., respectively.

this installation are modern, but cannot be expanded because of the unavailability of additional land. These facilities will be transferred as the new research center is constructed, and there will be no interruptions to the continuing research program. The company does not anticipate that the Verona facilities will be completely given up for at least four years.

Clopay Buys Detroit Company

As the first step in its program of diversification through acquisition, Clopay Corp., Cincinnati, O., has purchased Closures, Inc., Detroit, Mich. The transaction makes Clopay one of the country's largest manufacturers of plastic and reinforced folding doors and room dividers, since it adds the higher-priced door lines of Closures to the inexpensive folding doors made by Clopay. Closures will be operated as a division of Clopay, with separate sales and manufacturing units located in Detroit.

Anti-Trust Suit Dismissed

On June 11, the United States Supreme Court upheld, by a vote of four to three, the District Court's dismissal of the government's complaint in the cellophane anti-trust suit against E. I. du Pont de Nemours & Co., Wilmington, Del. The original complaint, filed in December 1947 by the Anti-Trust Division of the Department of Justice, charged that du Pont had monopolized, and combined and conspired to monopolize, the manufacture and sale of cellophane and cellulose caps and bands.

The case came to trial on January 17, 1951, in the District Court of the United States for the District of Delaware. This court ruled on December 14, 1953, that the government's complaint should be dismissed. The government appealed this decision for cellophane, but did not appeal the dismissal of the charges relating to cellulose caps and bands. Du Pont's successful defense was based on the contention that it did not possess the power to control prices and exclude competitors.

Construction Underway

A two-story air conditioned office building with over 91,000 square feet of space is currently under construction by Fischer & Porter Co.'s maintenance personnel on the firm's 13-acre tract in Hatboro, Pa. The new unit, which includes a company cafeteria, will release a corresponding amount of space in the present plant for production facilities.

Unique, lift-slab construction (in which both floor and roof are laid on the ground and then raised to their respective heights) is being employed. Exterior walls will be yellow, with porcelain-coated aluminum panels. Luminous ceilings will be used to provide glare-free illumination, as well as efficient sound absorption.

Alsynite Co. of America's new office building.

Completes New Office Building

The recently-completed new office building for Alsynite Co. of America, San Diego, Calif., is planned for efficient operation. The building, which adjoins the plant and technical department, has a 92-foot frontage and is 40 feet deep for a total coverage of 3,680 square feet. The rectangular structure is divided into four sections; administrative, accounting, advertising, and sales. The facility will accommodate a staff of 50.

All doors are wood frame with Alsynite fiberglass panels. Ceilings are of acoustical, perforated tile of fireproof fiberglass. Lighting is diffused through corrugated Alsynite, and the company's fiberglass panels are used as partitions throughout the building. Office windows feature shatterproof Alsynite panels in the lower halves; a ¼-inch panel forms the front entrance door; and a ventilated patio forms part of the rear structure.

Interchemical Buys Angier

The adhesives business of Angier Products, Inc., Cambridge, Mass., has been acquired by Interchemical Corp., New York, N. Y. The acquisition involves the transfer of the Angier manufacturing facilities and other properties in exchange for Interchemical stock. Founded in 1931, Angier has plants at Huntington, Ind., and Cambridge. It will now operate as Angier Adhesives Division of Interchemical, with its present management and staff. Henry S. Bothfeld, Angier president, will become division president of the new Interchemical unit.

Eagle Rubber Expands Again

As part of an over-all expansion program begun in 1952, Eagle Rubber Co., Inc., Ashland, O., has purchased a two-story brick building next to the main plant site. The new facility adds approximately 40,000 square feet of floor space, bringing the present total to 140,000 square feet of factory and office space.

Utilization of the newly-acquired building will free other areas within the plant for production purposes. Eagle produces rubber and vinyl ballons and sports equipment, and vinyl squeeze toys.

Eagle's recently acquired facility.

Survey Shows Waning Bias Against Plastic Housewares

Old prejudices against the use of plastics in kitchen items are waning, according to a recent survey made by the Polychemicals Department, E. I. du Pont de Nemours & Co., Wilmington, Del. The survey was conducted in "Plasticstown, USA," an existing city of 100,000 inhabitants chosen for its representative nature. Housewives were questioned as to their likes and dislikes of plastic housewares in order to determine how their preferences and buying habits can guide the plastics industry in improving consumer products.

When asked to compare the advantages of using plastic material in kitchen items to those made from glass and metal, 63% mentioned the resistance of plastic to breakage; 15% said that they were easily kept clean; 8% liked their light weight; and 8% claimed they were easy to handle. Disadvantages of plastic kitchenware items were tabulated as follows: 37% said there were none; 19% disliked their heat distortion; 15% stated that hard plastics crack and break easily; 13% felt that they retained an after-odor from foods; and 4% objected to food stains and discoloration.

The majority of those interviewed stated that the most popular plastic kitchen item was the refrigerator storage container; 39% owned containers of soft, flexible plastic, while 19% possessed hard, rigid plastic containers.

Answers to color preferences in plastic housewares indicated that the traditional bright red and bright yellow still led the field. When shown the newer pastel shades, 34% picked pastel green; 32% bluegreen; 28% coral; and 19% pastel blue.

More than 40% of the housewives preferred that plastic kitchen items be tagged or labeled. When asked the type of informative material that would be most helpful if put on a label or tag, 40% wanted care-of-product and cleaning instructions; 30% wanted reaction to heat and cold; 31% asked for information on how to use the product; 29% wanted the specific features of the material (such as taste, odor, etc.); and 21% wanted the brand name of the product itself.

The housewares survey is the first of a series of similar studies planned by DuPont.

Sees Wide Use of Polyethylene Film to Protect Crops

Millions of acres of crop land are likely to be covered with polyethylene film in the next decade, according to C. E. Staff, Bakelite Co., New York, N. Y. During the past few years, it has been demonstrated that black film made from specially-formulated polyethylene is an inexpensive way to keep weeds under control, reduce irrigation costs, and produce more and better fruits and vegetables.

Since 1953, agricultural uses of polyethylene film have grown from a few test patches to "Magic Carpets" covering several hundred acres. "Magic Carpet" is a term used by strawberry growers in Southern California, who are using the film to keep ripening berries from coming into

contact with moist ground. By reducing mold rot and disease, the film increases the marketable yield of strawberries by a third. In addition, the film blanket keeps the soil warmer, thus forcing the plants to early maturity.

Black film made from specially-formulated polyethylene does not deteriorate in the field, and can be left in place for several plantings if the edges are held down firmly with soil to protect against wind damage. Since the black film cuts off light, weeds smother and plants grow only where slits have been cut.

Vinyl and polyethylene films also can be used to line irrigation ditches and farm ponds to reduce water seepage, Dr. Staff noted. Opaque films appear to have the edge in irrigation ditch lining, since they also prevent the growth of weeds. Uncolored film has proved successful in the building of commercial greenhouses, and this greenhouse technique is now being extended to row crops in the fields.

Silage protection is another growing use for the films on the farm, and large polyethylene tubes, 20 feet in diameter, make excellent temporary silos for surplus crops. On the open range, opaque films might be stretched over rough frames to provide shelter for cattle, Dr. Staff stated. The film also can be used as insulation on chicken coops, sheds, and other inexpensive farm buildings which do not require year-round protection.

New Research Center Planned

A 176-acre tract of land near Monroeville, Pa., has been purchased by Koppers Co., Inc., Pittsburgh, Pa., as the site for a new multi-million dollar research center. The company expects the scope of its research program to triple within the next 10 years, and the new site will provide the necessary research facilities to take care of needs for many years to come. Tentative plans call for a research center consisting of laboratories, pilot plants, power plant, administration building, and auxiliary facilities. These units will be constructed over a period of years, and construction of the first building, a chemical laboratory, will begin next year.

At present, the majority of Koppers' research work is carried on at the firm's Verona, Pa., research center. Facilities are modern, but cannot be expanded due to unavailability of additional land.

To Enlarge Pigments Plant

Final approval to plans for enlarging its plant has been given by Pennsylvania Color & Chemical Co. Following grading work on the site, new construction will get under way at once. The new unit is expected to be in operation some time during the first quarter of next year. The added facilities will make possible an increase of about 20% in plant output. Some of this added capacity will be for the manufacture of pigment dispersions in vinyl resins.

In Brief . . .

Carbide & Carbon Chemicals Co.'s fine chemicals department, New York, N. Y., has announced the availability of propionic acid in tank car quantities. An intermediate in the manufacture of vinyl propionate monomer, and a raw material for cellulose propionate and adhesives, propionic acid is made from Oxo-derived propionaldehyde.

Wm. M. Fiore, Inc., has moved from 135 Liberty St., New York City, to 269-41st St., Brooklyn 32, N. Y. The firm will have double its previous space allotment for manufacturing electroformed spray masks and fixtures.

Celanese Corp. of America, New York, N. Y., has announced the appointment of Great Western Chemical Co., Inc., as distributor for Marco products and polyester resins in Oregon, Washington, Idaho, and Alaska. The firm maintains offices in Seattle and Portland.

Acheson Dispersed Pigments Co., Philadelphia, Pa., has announced price reductions of 25-40% for its PVC, vinyl copolymer, and polystyrene colorants. These reductions are reportedly due to improved processing and completion of the new plant in Orange, Tex.

Celanese Corp. of America, New York, N. Y., has established graduate fellowships in 13 universities, covering the following fields of study: physics, chemistry, engineering, textiles, cellulose, and plastics.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has appointed General Plastics Corp., Paterson, N. J., as distributor for Armalon, its Teflon-coated glass fabric.

Thermal, Inc., has moved to a new factory and offices at 9400 Robinson Road, Franklin Park, Ill. The new facility covers over 10,000 square feet, and is expected to take care of expanded production needs.

Elm Coated Fabrics Co., Inc., has announced removal of its New York sales office and salesroom to 261 Fifth Ave., New York City. The converting department and inventory are now accommodated by the new 60,000-square foot extension to the 220 Stewart Ave., Brooklyn, plant site.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has appointed the following distributors for its Armalon tetrafluoroethylene single-coated glass fabrics: General Plastics Corp., 165 Third Ave., Paterson, N. J., and American Durafilm Co., 2300 Washington St., Newton Lower Falls, Mass.

"What's different about GREX?"

Ed: We've been hearing a lot lately about GREX. What's so different about it, anyway?

Dave: It's the new high density polyethylene resin. Enormous potential in molding and extruding. Remarkable material.

Ed: How so?

Dave: Well, GREX isn't like ordinary polyethylene. GREX has an orderly molecular arrangement . . . the polymer chains are nearly parallel, and packed close together. Tight packing means fewer spaces between. So it's called "high density" . . . or "linear" polyethylene. You've seen the straight line molecule in GREX advertising. That means "linear".

Ed: Hm, that tight packing should give it better stiffness. Probably better heat resistance, and less permeability, check?

Dave: Right.

Ed: Sounds good. Available now?

Dave: Sample quantities . . . soon. Think we should try it?

Ed: Yessir!

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News from Abroad

Plastics in France, 1955

Production and consumption in the French plastics industry have more than doubled in the three-year period 1953-1955. In 1953, total production came to 42,720 metric tons. This increased to 73,330 tons the following year, and again to 96,245 tons last year. Consumption in the same years rose successively from 57,830 to 85,670 and 108,411 tons. To the 1955 figure should be added about 100 tons of epoxy resins, 500 tons of casein resin, and a small quantity of polyurethanes. Per capita consumption in 1955 was 2,502 grams (about 5.5 pounds) of which 28% was PVC, 16% phenoplasts, 13% aminoplasts, 11% polystyrene, and 10% soluble resins.

France imported 22,154 metric tons of plastics in 1955, chiefly from the United States (polystyrene, polyethylene and acetobutyrates), Germany (PVC, PVA, and acrylics) and Britain (aminoplasts and cellulose acetate), but she also exported 9,691 metric tons, of which almost 40% consisted of PVC and about 19% each were of polystyrene and polyamides. The most important customers were Switzerland (polyamides), Argentina (PVC and polystyrene) and the Benelux countries (PVC).

It is interesting to follow the development of Germany as supplier of plastics to France, apparently at the expense of Canada. In 1953, the United Kingdom, United States, Canada, and Germany, in that order, sent practically equal amounts of plastics to France, and the share of the United Kingdom was only 350 tons more than that of Germany. The following year, the United States ranked first, with Canada a poor second and Germany only two tons behind Canada. In 1955, Canada had dropped to seventh place, but Germany was a close second to the United States which was first again with 500 tons less than the year before.

Several new undertakings and expansions have already reached completion, or will reach it later this year, and total French productive capacity for 1956 is expected to come to 146,300 metric tons.

The following table gives French production and consumption of plastics in metric tons, in the years from 1953 to 1955 and the estimated production capacity in 1956. This estimate is 50% higher than the 1955 total.

	Production			Consumption			Estimated Production Capacity,
	1955	1954	1953	1955	1954	1953	1956
Cellulosics	4,800	5,000	4,000	5,700	5,230	4,850	9,000
PVC	32,200	24,000	16,000	30,702	21,820	17,400	38,000
PVA	5,000	3,000	—	5,846	3,940	—	7,500
Acrylics	985	830	540	1,896	1,460	1,250	1,300
Polyamides	3,240	800	—	1,418	800	1,200	5,500
Polystyrenes	11,600	8,000	3,620	12,339	12,090	8,950	18,000
Polyethylene	3,990	1,800	—	6,780	5,500	1,300	8,000
Phenoplasts	14,500	12,480	6,200	17,200	13,820	7,700	20,000
Aminoplasts	10,550	9,400	4,660	14,500	12,130	6,800	15,000
Soluble Resins	7,770	7,800	7,700	10,800	8,400	8,100	20,000
Silicones	180	150	—	180	300	250	500
Polyesters	910	70	—	1,050	180	30	3,500
Casein	500	—	—	—	—	—	—
Totals	96,245	73,330	42,720	108,411	85,670	57,830	146,300

Estimates of the equipment in use in the French plastics industry in January of this year indicate some 4,000 injection molding machines, of which 712 were bought in 1955. Capacities ranges from under 45 grams (more than half the machines) to 2,000-4,000 grams. There were eight machines in the 4,000-gram bracket, and four were bought in 1955. In addition, it is calculated that there are some 3,900 compression molding machines in use, 1,300 extruders, 2,000-2,500 high-frequency welding machines (up to 3 kw.), 1,500 infra-red welders, also 44 vacuum forming machines.

Three new enterprises will be ready to produce polyethylene before long. Societe Ethylene Plastique will shortly establish a branch in which Pechiney, L'Air Liquide, and Huiles, Goudrons at Derives are to participate. The new firm intends to start by making 10,000 tons of polyethylene annually, utilizing the I.C.I. process for which Ethylene Plastique already holds a license, and will operate a factory at Port-Jerome (Seine-Maritime): It is expected to obtain the necessary ethylene from Esso Standard.

Another company is reportedly to be formed by Air Liquide and Huiles Goudrons et Derives to make polyethylene by the Ziegler process, with license and technical know-how to be obtained from Houilleres du Bassin du Nord et du Pas-de-Calais. This form, too, will be at Port-Jerome, and also expects to use ethylene from Esso Standard.

Finally, it is learned that the Societe des Usines Chimiques Rhone-Poulenc has obtained sole license from Phillips Petroleum Co. for its new process for making rigid polyethylene.

Plastics in West Germany, 1955

Production of plastics materials and products in West Germany enjoyed another successful year in 1955. Output of materials reached a total of 428,945 metric tons, an increase of 27% over the previous year. Production, in metric tons, and the percent change from 1954 are shown in the following tabulation:

	1955 Total	Change, %
Cellulosic plastics:		
Nitrocellulose	12,794	+10.1
Celluloid	3,910	—0.6
Other (by difference)	33,966	+18.5
	50,670	+14.6
Synthetic resins & molding compounds		
Condensation products	173,386	+27.7
Polymerization products	200,509	+30.6
Other (by difference)	4,380	+11.3

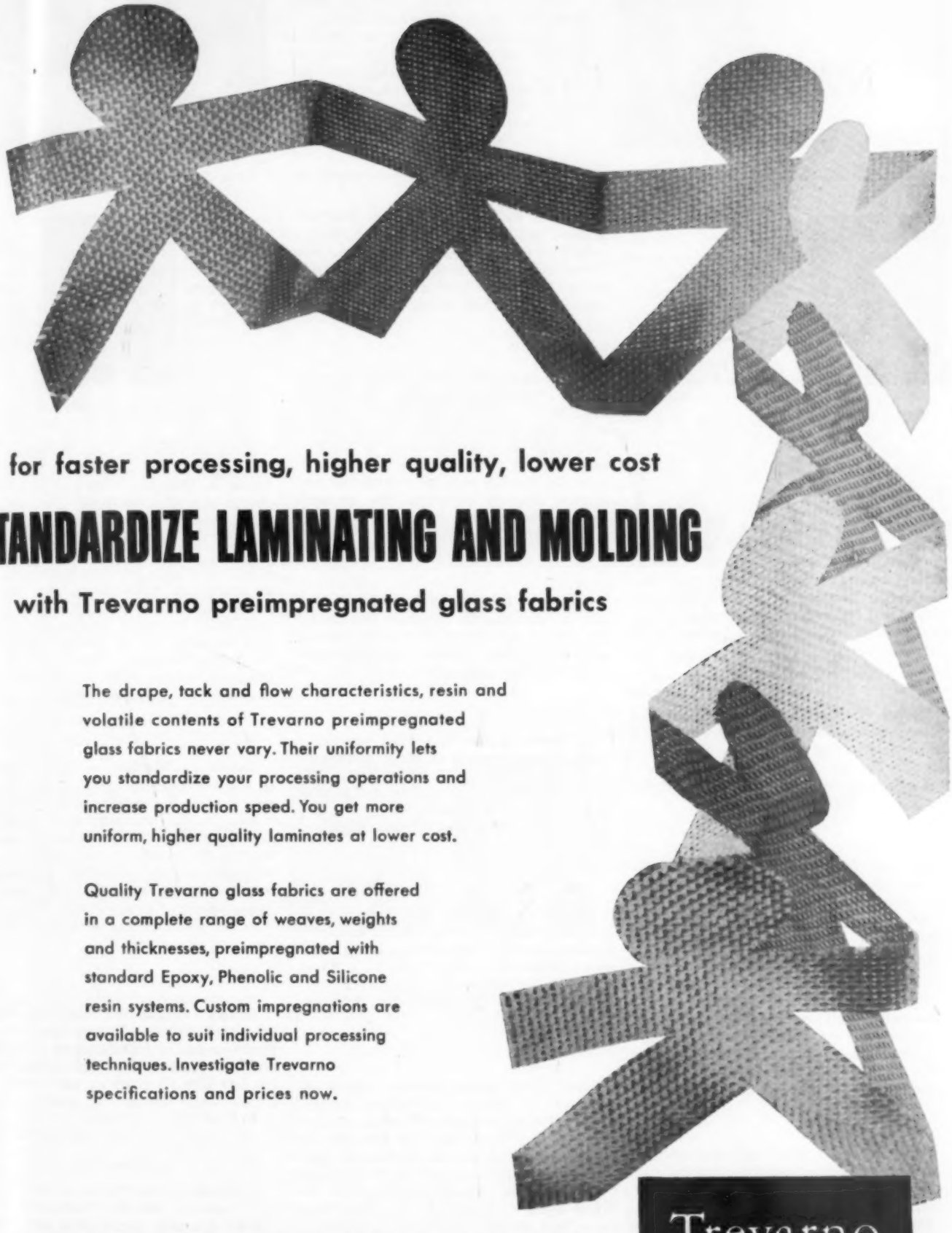
PVC continued as the most important polymerization product, and capacity is being expanded to reach about 45,000 metric tons by the end of this year. High-pressure polyethylene production amounted to about 5,000 tons, and is expected to reach 10,000 metric tons as new producing facilities go into production.

Production and sales by the plastics products processing industry maintained the pace set in 1954. Value of output in 1955 was estimated at 929.8 DM on the basis of data for the first three quarters of the year, a value about 34% above the 1954 total. Competition among processors sharpened in 1955, and unused capacity estimated at 30% existed at the end of the year.

The values of West Germany's production of plastic parts in 1955, by the type of industrial consumer, are listed below:

	Value, 1,000 DM
Machinery industry	38,757
Vehicle and shipbuilding field	22,966
Electro-technical industry	156,331
Precision instruments & optics	30,351
Iron, sheet, & steelware fields	10,554
Textile & clothing industry	71,697
Shoe industry	6,905
Household use, etc.	89,442
Coatings, hose, & profiles	312,108
Other plastic goods & parts	190,740
	929,849

(*Continued on page 560*)



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NAMES in the NEWS

Clare E. Bacon

Clare E. Bacon, manager of custom molders sales for Owens-Corning Fiberglas Corp., New York, N. Y., has been elected chairman for the coming year of the Reinforced Plastics Division, Society of the Plastics Industry, Inc., succeeding **Samuel S. Oleesky,** Zenith Plastics Co. Holder of a B.S. in chemistry, Mr. Bacon has been with Owens-Corning since 1941, serving as manager of research and development, manager of product development, and manager of technical sales service before assuming his present post early this year.

Horace O. Kippels has been appointed senior engineer in Mobay Chemical Co.'s design engineering department, New Martinsville, W. Va. He previously served as area maintenance engineer at Monsanto's Texas City, Texas, plant.

Anthony J. Bruno, Jr., has been appointed technical department head of the Grex polyolefin plant, currently being built by W. R. Grace & Co.'s polymer chemicals division. Mr. Bruno was formerly chief engineer for Escambia Bay Chemical Corp.

James R. Davidson has been appointed executive secretary of the Society of Plastics Engineers, Inc., Greenwich, Conn., effective July 1. He formerly was sales manager for Hoosier-Cardinal Co.

Three central research staff appointments have been announced by the chemical divisions, Food Machinery & Chemical Corp., New York, N. Y., as follows: **Dr. O. C. Karkalits,** as process and economic appraisal supervisor; **John E. Zarembo,** as supervisor of general analytical services; and **John P. Alden,** as technical information service supervisor. Pending completion of the company's new research center near Princeton, N. J., all three men are located at the administrative headquarters in New York City.

Wallace B. Bateman, Jr., has been appointed sales manager for Famco, Inc., a subsidiary of American Air Filter Co., Inc., Louisville, Ky. In his new position, he will devote his time to the development of the company's glass fiber sales.

T. W. Sharp has been named manager of the industrial products department, Bakelite Co., New York, N. Y. He formerly was manager of the firm's flexible packaging materials division; in his new post, he will be responsible for sales of both the flexible packaging materials and surface coatings divisions. He succeeds **Howard Smith,** who was promoted to assistant general sales manager.

Robert F. Kipp will head sales promotion in the plastics industry for Oakite Products, Inc., New York, N. Y., manufacturers of cleaning and descaling compounds and equipment.

A. James Fisher has been appointed general sales manager of Metal & Thermit Corp., New York, N. Y. He brings to this position a background of 20 years' experience in industrial chemical sales, and has been with Metal & Thermit since February 1955.

Morris A. Kimmel has been named executive assistant to the general manager, Resinous-Reslac Department, chemical division, Borden Co., New York, N. Y. Long active in the adhesive compounding field, he has been with Borden in Peabody, Mass., since 1941.

John Albert Smith has been appointed engineer in charge of semi-automatic presses for Hull-Standard Corp., Abington, Pa. Mr. Smith has had 19 years of experience as a hydraulic engineering specialist and design engineer for F. J. Stokes Co., American Engineering Co., R. D. Wood Press Co., Baldwin-Lima-Hamilton Corp., and others.

Gustave Ferri has been named plant manager of the Fitchburg, Mass., plant for Celluplastic Corp., Newark, N. J. Mr. Ferri joined the company in 1951 and, prior to his promotion, served as chief engineer.

Frank J. Groten

Ernest T. Handley

Irving Kaufman Studios

Kenneth L. Edgar

Firestone Plastics Co., Pottstown, Pa., has announced the following promotions: **Ernest T. Handley,** from vice president in charge of production to executive vice president; **Frank J. Groten,** from chemical sales manager to vice president in charge of chemical sales; and **Kenneth L. Edgar,** from Velon sales manager to vice president in charge of Velon sales. Mr. Handley joined Firestone in 1927; has been associated with Firestone Plastics since 1948; and will continue as general manager of the Pottstown plant. Messrs. Groten and Edgar have been with the company since 1941 and 1940, respectively.

Arthur G. Ringlen has been appointed to the newly-created position of chief engineer of J. E. Plastics Mfg. Corp., New York, N. Y., manufacturers of acetate containers. He will be in charge of converting the plant to automation, in line with the company's expansion program. He was previously associated with American Safety Razor Corp., Gruen Watch Co., Western Electric Co., and Ward Baking Co.

Sidney Pinhasik has joined the laboratory staff in the Chicago plant of the Resinous-Reslac Department, chemical division, Borden Co., New York, N. Y. He has had 12 years of experience with United States Rubber Co., Union Asbestos & Rubber Co., and Armour & Co.

S. Philip Marcus has been named business manager for the Princeton, N. J., central research laboratory, now under construction, of the chemical divisions, Food Machinery & Chemical Corp., New York, N. Y. Mr. Marcus received his B.S. and M.S. degrees in chemical engineering from Carnegie Institute of Technology, and was formerly administrative assistant to the vice president and technical director of FMC.

...mes in the News (Cont'd)

...E. D. Lutz has been promoted to manager of flooring distributor sales for the ...ns & flooring division, Goodyear Tire ...Rubber Co., Akron, O. With Goodyear ...ce 1943, he handled merchandising and ...es development of vinyl and rubber ...oring since November 1955.

J. K. Moffett, Jr., has been transferred ...a sales development post for Petrothene ...olyethylene resins for U. S. Industrial ...hemicals Co., New York, N. Y. With the ...m since his graduation from college in ...948, he has served as supervisor of the ...dium peroxide plant and as head of ...dium peroxide sales.

William M. Gearhart and **R. B. Herring** ...ve been named manager and chief ...emist in charge of the laboratories, respectively, for the newly-created chemical ...les development section of Eastman ...hemical Products, Inc., New York, N. Y. ...r. Gearhart formerly was chief chemist ...charge of the service and development ...boratories at Kingsport, Tenn., while ...r. Herring had been his assistant. The ...w section, which is separate from the ...mpany's commercial sales department, ...ill handle all work with new products ...nd those under development.

Richard C. Burck has been promoted to ...oduct development supervisor for Mobay ...hemical Co., St. Louis, Mo. He joined ...e firm in February 1955 as a development ...gineer, and has been active in the commercial development of urethane products. ...his new post, Mr. Burck will coordinate ...nd supervise the market introduction of ...rethane products now in the process of ...eld evaluation. He received a B.S. in ...emical engineering from the University ...f Michigan in 1947; then joined Minne...ota Mining & Mfg. Co. as an engineer, ...efore coming to Mobay.

John A. Cushman has been named man...ger of American Viscose Corp's cello...phane plant at Marcus Hook, Pa. He had ...een serving as chief plant engineer at ...Avisco's Fredericksburg, Va., unit.

Michael Pisetzner has been elected vice president and general manager of American Molding Powder & Chemical Corp. and A. Bamberger Corp., both of Brooklyn, N. Y. **Herbert H. Goldmark** continues as ...ice president and general sales manager, ...hile Roy **A. Sorenson** has been appointed production manager. Mr. Pisetzner was ...formerly chief of research and develop...ment and assistant to the president for ...Ansbacher-Siegle Corp., Mr. Sorenson pre...viously was with Nixon Nitration Works ...s chief chemist, production manager, and, ...finally, assistant general manager.

John O. Tragard has been appointed industry manager for rubber and plastics by Industrial Nucleonics Corp., Columbus, O. He served as general assistant to the vice president and, later, as manager of sales maintenance for Foxboro Co.; a consultant to the War Production Board; eastern division sales manager for Fulton Sylphon; and as vice president and general sales manager for Hammel-Dahl Co.

James F. Hall, Jr., has been appointed an industrial chemicals sales representative in the Chicago area for Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. He joined the firm in 1953, and for the past two years was a representative for the plasticizer division.

Donald M. Fay has joined Durable Formed Products, Inc., New York, N. Y., as technical field representative, and will be available for product development sales work.

P. James Underwood has resigned as executive secretary of the Society of Plastics Engineers, Inc., Greenwich, Conn. Mr. **Underwood** served in this position for the past three years, in which time SPE membership grew to over 5,000 individuals in 38 geographic sections in this country, Canada, and Japan. **Mr. Underwood** is returning to Washington, D.C., to resume his work towards a career in law.

P. L. Williams

J. S. McBride

Phillip L. Williams has been named manager of reinforced plastics engineering development for Owens-Corning Fiberglas Corp., Toledo, O., and **John S. McBride** has been appointed technical manager of the plastics reinforcement laboratory. Mr. Williams' position is newly-created and carries with it the responsibility for determining and carrying out projects necessary to establish Fiberglas-reinforced plastics as a structural material. With the firm since 1948, Mr. Williams formerly was manager of distribution sales for the company's plastics reinforcement division. In his new post, Mr. McBride will direct research and testing programs required to establish engineering design data, cost-performance relationships and other data needed to increase the use of reinforced plastics in engineered structural applications and other products. He has been with Owens-Corning since 1951.

Harry P. Schrank

Harry P. Schrank has been elected executive vice president of Seiberling Rubber Co., Akron, O. A member of the firm since 1926, he has been serving as production vice president for the past 20 years. In his present position, Mr. Schrank will function as chief administrative officer.

Nosco Plastics, Inc., Erie, Pa., has announced the following promotions: **Ruben G. Kugel,** former treasurer, to vice president and treasurer; **S. L. Potter,** former controller, to vice president and controller; **Paul C. Roche,** former sales manager, to operations manager; **H. Brainard Brown,** former purchasing agent, to chief production engineer; **Charles Wingerter,** former chief inspector, to purchasing agent; and **George DeHaven,** former inspector, to chief inspector.

David M. Stettler has been appointed assistant to **James K. Ames,** Chicago district manager of Colton Chemical Co., division of Air Reduction Co., Inc., Cleveland, O. The Chicago district has been expanded to include Minneapolis, St. Paul, Kansas City, St. Louis, and Wichita.

Edmund Greene has been appointed director of marketing research for Monsanto Chemical Co., St. Louis, Mo., succeeding **Shea Smith III,** who recently became assistant to the president. **Mr. Greene** had been assistant director of Monsanto's advertising department.

Charles J. Bahun and **K. U. Patel** have joined the laboratory staff of Durite Products, a department of Borden Co.'s chemical division. **Mr. Bahun** will serve as group leader in charge of molding material development at the Durite plant in Philadelphia, Pa. **Dr. Patel** will serve on the development staff as chemical engineer.

R. W. Swinehart has been named superintendent of cellulose products for Dow Chemical Co.'s plastics production department, Midland, Mich. A 25-year man, Swinehart succeeds **Merrill H. Weymouth,** who recently was named manager of the Hanging Rock Styrofoam plant, Ironton, O. **Paul Greenfield** replaces **Mr. Swinehart** as director of the Cellulose & Plastics Laboratory, and **Malcolm Chamberlain** succeeds **Mr. Greenfield** as assistant director of the laboratory.

(*Continued on page 560*)

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Amine-Type Epoxy Hardener

A relatively non-toxic, amine-type hardener for epoxy resins has been introduced by Furane Plastics, Inc. Designated Promoter D-40, the material features a high boiling point and low order of reactivity.

Up to 40 pounds of clear resin have been prepared using D-40, the largest clear castings produced in a single pour. Circuits requiring 1-5 pounds of resin are cured at temperatures of 140-160° F., producing exotherm in the order of 20-40° F. over the existing oven temperatures.

A slow curing cycle (15 hours) at lower temperatures produces gelation after 5-8 hours, forming a relatively strain-free polymer network. In addition to electronic insulation, bubble-free epoxy castings can be produced for valve-body housing prototypes, vacuum-chuck plates, and drill jigs. Promoter D-40 is used in the proportion of 15 parts by weight to 100 parts of a clear-base epoxy resin such as Epocast 6010. Properties of such a formulation are listed as follows:

Color	Amber
Specific gravity	1.2
Cure time at 165°F., hrs.	16
Post-cure at 300°F., hrs.	1
Pot life, hrs.	24
Tensile strength, psi.	11,000
Flexural strength, psi.	15,500
Compressive strength, psi.	20,200
Modulus of elasticity, E_c	3.9×10^5
Barcol hardness, gage 934-1	29-31
Weight change, 2 hrs. boiling water, %	1.8
After 24 hrs. immersion in water (room temp.), %	0.28
Heat distortion, °F.	176
Dielectric constant at 110 kc	4
Power factor	0.053
Dielectric strength, ⅛-in. section, volts/mil	400

Readers' Service Item M-1

Polyurethane Foam Materials

A two-component formulation for producing foamed-in-place cellular plastics by the reaction of polyisocyanates and resinous polymers has been introduced by Nopco Chemical Co. Designated Lockfoam, the material is said to make an ideal potting medium for electronic instruments and a barrier against deterioration of electrical wire connections, resistors, condensors, and electron tubes.

Lightweight and strong because of its closed cell structure, Lockfoam is highly resistant to thermal distortion, moisture, vibration, and shock. The two ingredients are mixed in predetermined proportions, and the foam rises to encapsulate the entire system regardless of configuration. Post-cure at a temperature slightly in excess of that at which the unit is designed to operate will enhance the adhesive and mechanical properties of the finished foam. Flexibility and energy absorption properties can be controlled over a wide range of densities.

Physical properties are reported as follows:

Max. strengths, psi.: compressive	1,000
Shear	400
Tensile	575
Thermal conductivity, @ 75°F., Btu./hr.	0.2
Dielectric constant	1.06-1.6
Coefficient of linear expansion-/°C.	3.5×10^{-5}
Heat distortion temp., °F.	150-[illegible]
Minimum service temp., °C.	-192
Water absorption (total immersion, 24 hrs.) gms./cu.ft.	0.2
Flammability (except flame-resistant formulations):	
Ignition time, sec.	32.2
Flame travel, in.	4.67
Burning time, sec.	62.2

Readers' Service Item M-2

Vinyl Organosol Formulation

An organosol formulation, based on Pliovic AO vinyl resin, has been developed by Goodyear Tire & Rubber Co.'s chemical division, for the coating of nylon and cotton-fabric safety belts. Special features claimed for the formulation are high abrasion resistance and flexibility, factors which prolong the service life of the belt.

The formulation has been set up as follows: 100 parts Pliovic AO, 35 parts dicapryl phthalate, 15 parts di-isodecyl adipate, five parts Paraplex G-62, two parts Mark XV stabilizer, 1.5 parts Emcol 14, and 35 parts mineral spirits #10. The last-mentioned item is added during ball milling to control viscosity, and promotes optimum uniformity and stability. Color can be added as desired.

The fabric must be dried before coating, and singeing will eliminate surface irregularities. Optimum coating is obtained by slowly withdrawing the webbing from the bath. Drying at 250° F. drives off the organic solvents, and should be followed by a two-step fusion to eliminate creeping; five minutes at 310° F., followed by three minutes at 350° F.

Among the properties reported for the formulation are the following.

Shore "A" hardness	83
Adhesion, nylon belt, lbs./in.	10.5
Cotton belt, lbs./in.	18.5
Abrasion, wt. loss after 1,000 cycles Taber Abraser, gms.	0.2411

Readers' Service Item M-3

Two Polyethylene Resins

Two polyethylene molding compounds said to have a level of crystallinity above that of other commercial materials, have been introduced by E. I. du Pont de Nemours & Co., Inc. Designated Alathon 34 and 37, the materials are white, translucent solids in the form of ⅛-inch cubes, and are supplied in natural color only.

Both materials have a density intermediate between the conventional polyethylenes and the new linear materials. Alathon 34 is designed for film applications where greatly increased clarity, stiffness, sparkle, and high impermeability are re-

d. These properties should also make suitable material for molding bottles containers.

thon 37 is a high-flow polyethylene ded for general-purpose molding, and res fast cycle, high gloss, and stiffness. erties for the two materials are re- d as follows:

	Alathon 34	Alathon 37
ndex, dg./min.	1.9	12
c gravity	0.93	0.93
ss, psi.	40,000-45,000	40,000-45,000
e strength @ 73° psi.	1,640	1,520
strength @ 73° psi.	2,100	2,100
tion, %	410	100
softening temperature, °F.	224	222
crack resistance, Tel., hrs.	0.5	0.1
ness temperature,	—165	—158
"D" hardness	55	55
absorption, %	0.01	0.01

Reader's Service Item M-4

ydrogenation Catalyst

metal oxide dehydrogenation catalyst aining a high proportion of magnesium been introduced by Westvaco Mineral ducts, a division of Food Machinery & mical Corp. Designated Catalyst 1707, material is said to be particularly suited he dehydrogenation of ethylbenzene for production of styrene.

Continuous operation is possible, since on deposition is virtually nil under mal operating conditions. The pellets are hard, hence unaffected by moisture. alyst 1707 is available in 100-pound tiwall paper bags and 400-pound fiber ms. Properties are as follows:

Content, % maximum:	
Water	2
Magnesium oxide	62
Ferric oxide	16-19
Cupric oxide	3.5-4.5
Potassium oxide	4-6
Crushing strength, lbs.	17.5
Bulk density, lbs./cu. ft.	75-87
Average particle size,	
length, in.	3/16
Diameter, in.	3/16

Reader's Service Item M-5

dhesive for Polyurethanes

A liquid adhesive for bonding polyurein foams has been developed by the sinous-Reslac department of Borden 's chemical division. Called Arcco 518, the material is available in brush scosity, but may be thinned for use in ray applications.

For bonding the foam to itself, fabric, or per, the adhesive is applied on a wetk basis. One or both surfaces are ated, depending upon bond requirements, d pressure is applied. Advantages include t drying, freedom from odor, and flexible nd. Total solids content is reported at 14%, and the weight per gallon at 6.7 pounds. Viscosity is 600 cps.

Readers' Service Item M-6

Conductive Organic Coating

An electrically-conductive organic coating, which is resistant to chemicals and to corrosion, has been introduced by Alfred Hague & Co., Inc. Called Rubalt No. 538-L Black, the material can be applied by brush, spray, or roller coating.

Drying time is approximately 15 minutes; however, force drying at a slightly elevated temperature is recommended to remove the last traces of solvent. Adhesion is reportedly excellent, regardless of the type of surface. For one coat, the conductance between two points, one inch apart, ranges from 1×10^{-4} to 9×10^{-4} mhos. Since conductance varies with the carbon content, multiple coats increase the conductance, while admixing of a clear vehicle will reduce same.

In addition to providing a conductive path on otherwise non-conductive surfaces, the material acts as a static eliminator and as an electrostatic shield in cathode ray tubes. It is also of use in printed circuits.

Reader's Service Item M-7

VANSTAY Z

zinc bearing chelator for PVC resins imparts outstanding clarity, stability and resistance to sulfur staining when used as recommended with other VANSTAYS in many vinyl products.

Plastisols, Organosols, Extruded Goods

Use 1.5 VANSTAY R with .5 VANSTAY Z for maximum resistance to process heat and good service life.

Film, Sheeting, Molded Products

Use 1–1.5 VANSTAY HT with .5–1.5 VANSTAY Z to obtain the required protection.

When Roll plating is a problem:

Use 1.5 VANSTAY N with 1.5 VANSTAY Z as the stabilizing system.

Our Technical Service Representatives will gladly demonstrate the merits of our materials in your plant and assist in solving production problems.

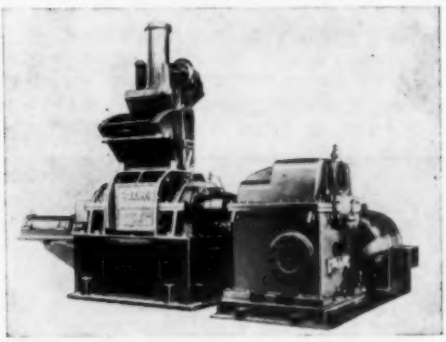
Oliver

R. T. Vanderbilt Co., INC.

230 PARK AVENUE, NEW YORK 17, N. Y.

New Equipment

Write item numbers on Readers' Service Card to obtain more information.



Spiral-Flow intensive mixer No. 10.

Spiral-Flow Intensive Mixer

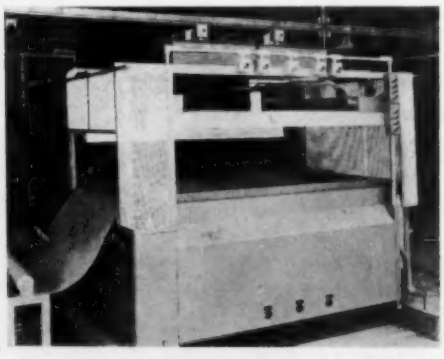
A line of mixers for plastics compounding, which offers virtually automatic operation through time and temperature controls, has been introduced by Stewart Bolling & Co., Inc. Designated as Spiral-Flow intensive mixers, the units are available in chamber capacities of 231, 3,450, 5,100, 12,160, and 16,000 cubic inches.

The mixers feature spiral-flow sides which allow efficient heating or cooling, split-end frames, rotors with full-circle end flanges, and anti-friction bearings. Advantages claimed for the machines include less power consumption, faster mixing and dispersion, longer life, lower maintenance costs, and high accessibility.

Readers' Service Item E-1

Automatic Drape-Vacuum Unit

A newly-designed vacuum and drape-forming machine with a maximum forming area of 48 by 72 inches has been introduced by Auto-Vac Co. Designated Model EQA, the unit is 96 inches wide, 131 inches long, and 78½ inches high. With pump placed in the rear, another 24 inches is added to the length.



Auto-Vac's Model EQA drape-vacuum former.

The drape frame features power drive with twin toggle action. Two-way stroke is adjustable from 0-12 inches. The frame itself is adjustable in one-inch increments from a size of 12 by 13 inches to the capacity of the machine. A variable bottom position from 3-15 inches permits various mold heights to be accommodated.

Operation is completely automatic. The operator loads sheet stock and presses the twin starting buttons. The machine cycles, and the clamp opens automatically. An air bleed-off valve lowers the drape frame when conversion to straight vacuum production is desired.

The heating area, 54 by 78 inches, is wired for 220/440 volts, three-phase, 60-cycle current or to specification. A five-hp. vacuum pump handles 99 cubic feet of air per minute, and provides 28 inches of operating vacuum. The 275-gallon reservoir is built into the machine. Air pressure required is 85-100 psi.

Readers' Service Item E-2

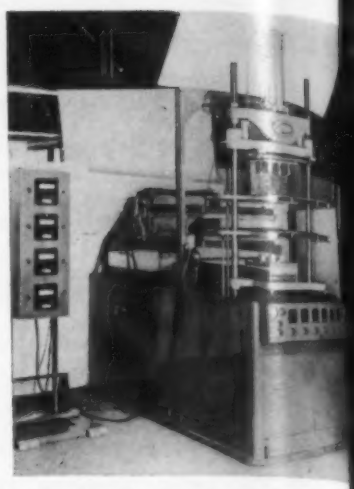
Vacuum Former and Trimmer

A machine which performs the entire fabricating process of vacuum forming, drape forming, and trimming thermoplastic sheets has been introduced by Vacuum Forming Corp. Called the Vac-Trim Model 246, the unit produces a design from sheet to end-product in one operation.

Model 246 performs straight vacuum forming using female molds; drape forming using male molds; and plug forming using plugs and female molds. Formed parts are trimmed by temperature-controlled trimming dies. Depth of draw is nine inches, and maximum mold area measures 24 by 24 inches.

Welded steel is used throughout, and the unit is completely enclosed with machine guards. The unit is interlocked for operator safety and to protect the moving parts. Heater is of sandwich-type construction. Platens are surface-ground cast iron, and are connected directly to the vacuum port. Water inlet and outlet are in the molds.

The vacuum system consists of a Beach Russ water-cooled vacuum pump, com-



Vac-Trim Model 246 vacuum forming & t ming machine.

plete with two-hp motor. Capacity is cubic feet per minute. The sheet mold clamped by a parallel motion wh guarantees positive clamping over all et of the sheet.

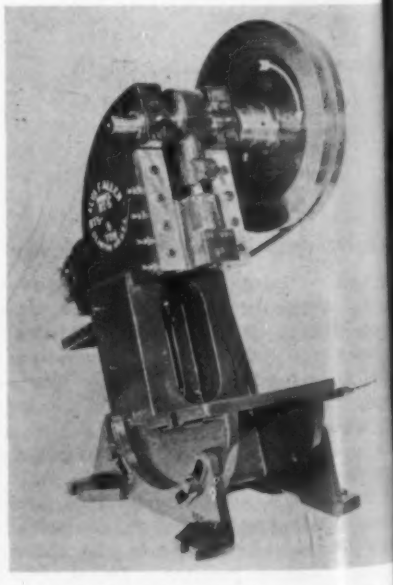
Readers' Service Item E-3

Bench-Type Punch Press

A five-ton, power driven, bench-t punch press has been introduced by A Allen Industries. Designated Model B the press will perform up to 280 operati per minute on continuous punching, she ing, forming, blanking, cutting, and dra ing operations.

The 65-pound flywheel assures am power for heavy-duty operations. The r per connecting rod-ram assembly is uniti for perfect alignment with crankshaft a die bed. Six-inch ram guides assure alig ment of the ram, and an adjustable, fl side gib compensates for wear.

Following are specifications repor for the press:



Model B-5 power bench-type punch press.

Height, in.	31
Crankshaft diameter, in.	1⅛
Base size, in.	13 x 14
Stroke, in.	1¼
Ram guide length, in.	6
Ram length, in.	7
Punch diameter, in.	1
Flywheel diameter, in.	14
Motor, hp.	1/3
Speed, rpm.	1,725
Weight, less motor, lbs.	265

Readers' Service Item E-4

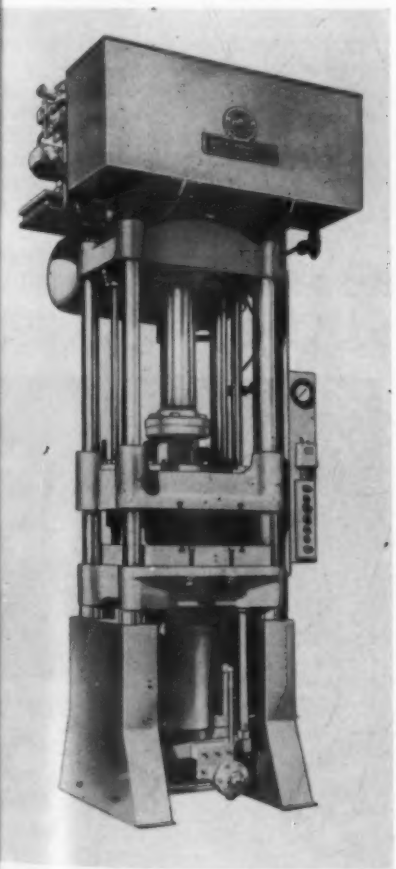
Four-Post Vertical Presses

A line of hydraulically-operated platen presses, ranging in capacity from 50-400 tons, has been introduced by Rodgers Hydraulic, Inc. Available with square or rectangular platens ranging in size from 18 by 18 inches to 48 by 72 inches, the presses will operate either semi-automatically or manually.

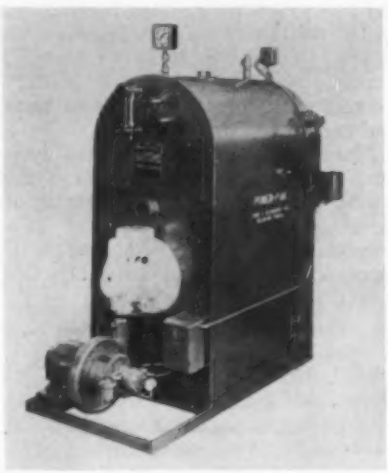
Features include heavy cast alloy steel platens, pressed bronze guide bearings, polished steel guide posts, seamless steel cylinders, and a combination of Denison and Vickers pumps. Specifications for the 50- and 200-ton models are reported as follows:

	50-ton	200-ton
Platen size, in.	18 x 18	30 x 30
Distance between platens, max., in.	24	36
Stroke, in.	14	30
Cylinder diameter, in.	5	1-10
Speeds, fast approach, in./min.	265	400
Max. tonnage	10	14
Pressing, in./min.	30	20-90
Max. tonnage	50	80-200
Return, in./min.	650	600
Max. tonnage	4	9

Readers' Service Item E-5



Rodgers' vertical hydraulic press.



Power-Pak automatic, low-pressure boiler.

Low-Pressure Steam Boiler

An automatic, low-pressure boiler for oil or gas firing has been introduced by Orr & Sembower, Inc. Called the Power-Pak, the unit is designed to provide steam or hot water heating with power demands of 10, 15, 20, and 25 hp. It is said to be the only unit of its type and capacity which meets ASME standards of five square feet of heating surface per boiler horsepower.

The Power-Pak, like the company's larger Powermaster units, assures smokeless and efficient combustion. It is automatically responsive to load changes, and is quiet, clean, and fast steaming. Forced draft eliminates the need of a stack. A vent discharges the invisible products of combustion into the atmosphere.

The burner is mounted on the boiler; the ignition transformer is mounted on the air plenum. On oil-fired models, a single motor drives both the forced draft blower and the fuel pump. Combustion may be observed through a peep-sight in the door. Dimensions are as follows:

	Oil-fired		Gas-fired	
	10-hp.	25-hp.	10-hp.	25-hp.
Length, in.	61	86	67	92
Width, in.	34	36	34	36
Height, in.	66	74	66	74
Weight, lbs.	1,750	2,800	1,750	2,800

Readers' Service Item E-6

NEW!
AUTOMOLD
FULLY AUTOMATIC
high speed
compression
molding machine
designed by molders specifically for molders' needs.
AUTOMOLD
Needs no operator. Cycles continuously. Just adjust to start—refill with raw material as needed—then remove a constant stream of finished products.
Lowest first and maintenance costs. Free counsel on mold design and production. Write for brochure on 25 and 50 ton models,
AUTOMATIC MOLDING MACHINE CO.
3217 F Exposition Pl., Los Angeles 18, Calif.

New Products

Write item numbers on Readers' Service Card to obtain more information.

Dynel acrylic fender covers.

Acid-Resistant Fender Covers

Auto-fender covers which are completely resistant to battery acid are presently available to repair shops and service stations through Industrial Textile Mills, a division of Industrial Wiping Cloth Co. Made of Dynel, Union Carbide & Carbon Corp.'s acrylic fiber, the cloths are of a single-weave, napped construction.

In recent tests, conducted by Texas College laboratories, the covers were sprayed with sulfuric acid and allowed to remain untouched for 40 hours. Following an industrial washing, the covers showed no outward signs of damage and a loss in tensile strength of only 24.5%. Cotton fabrics previously used showed 100% loss in similar testing. The covers are available from more than 200 Texel industrial laundry rental services throughout the country.

Readers' Service Item P-1

Crosbey's plastic boat features Plaskon-glass hull.

One-Piece Plastic Boat Hull

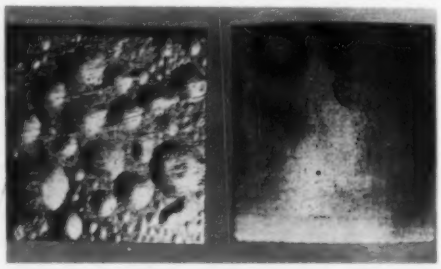
A line of pleasure craft featuring a one-piece, fibrous glass-reinforced Plaskon polyester hull has been introduced by Crosby Aeromarine, a division of Midwestern Industries Corp. High-buoyancy balsa wood flotation chambers are sealed within the resin-glass combination to create a truly unsinkable boat. In addition to impact resistance, the smooth plastic hull permits excellent performance in handling and maximum boat speed.

Mahogany decks are protected by polyester-base paint, which assures a lasting finish. Ten styles are available in three lengths: 12-foot, 14-foot, and 16-foot. Polyesters used in molding the hull are supplied by Allied Chemical & Dye Corp.'s Barrett Division.

Readers' Service Item P-2

Printed Circuit Laminates

A new line of copper-clad laminates for printed circuits, the HP series, has been introduced by National Vulcanized Fibre Co. This series is said to possess a bond strength of 12-15 pounds; twice that of grades previously available. A higher dip-solder temperature resistance of 30 seconds at 500° F., is also reported.



Copper clad test specimens after hot-dip solder test. HP series laminate (right) shows no blistering.

Production-wise, the HP series laminates are said to provide cleaner soldered joints, minimize bridging, and retain their bond strength after repeated heating and cooling. The process of manufacture involves forming a thin, cupric oxide layer which acts as a primer coat for the subsequent adhesive coating.

Readers' Service Item P-3

Herculite's vinyl-nylon hatch cover.

Vinyl-Nylon Laminated Cover

Bakelite's Krene vinyl film laminated both sides of a nylon fabric furnishes strong, but lightweight material used protect open cargo hatches from sud flash storms. Developed by Herculite P tective Fabrics, the covering weighs abo one-third as much as cotton duck can yet has a tear strength of 85 pounds a will not support combustion.

Since the laminate sheds water readi it can be stored without special care prevent mildew and mold. The coverin are electronically sealed, obviating t necessity for stitches which would be su ject to salt-water deterioration. Repa can be made with an ordinary patch ki

Readers' Service Item P-4

Extruded Nylon Window Strip

Extruded nylon strips are said to prov extra long life and smooth movement

Window channel uses nylon stripping.

e marine glass run channel for sliding ndows produced by Standard Products . The strip is cut to size from long coils Polypenco nylon, supplied by Polymer orp. of Pennsylvania.

Said to be the first channels designed for rizontally-sliding windows in marine apications, they utilize stripping 40 mils ick and 15/32-inch wide. In addition to w friction and long wear, the strip resists eterioration by both fresh and salt water. ver 503,000 wear cycles have been cometed on a wear-test machine, as well as xposure to salt spray for 1,000 hours; all ithout undue sign of wear or rust.

Core and trim bead are of Type 316 assivated stainless steel. The core is perorated to allow flexibility in the channel as small as a 2½-inch radius. A waterepellent, piled fabric inside the channel revents rattles and leaks. The nylon strip separated from the steel shell by a rubber-coated core and a strip of felt. Installaon-screw heads are drawn down into the ylon bottom for glass clearance.

Readers' Service Item P-5

Sprayable Vinyl Plastisol

A newly-formulated sprayable vinyl lastisol which produces film thicknesses

Micrometer measures thickness possible with single spray coat of Unichrome Super 5300.

up to 50 and 60 mils per spray coat has been introduced by Metal & Thermit Corp.'s electroplating and coatings division. Designated Unichrome Super 5300, the formulation permits gun applications of full solids content of vinyl plastisol without a diluent.

Pore-free coatings can be applied without seams or joints where corrosives might penetrate. Resistant to acids and other corrosives, the material forms a tough, flexible film which is resistant to chipping and abrasion. Acoustical and electrical insulating properties are good and, according to company sources, the coating permits the substitution of ordinary metals for expensive alloys.

Readers' Service Item P-6

Capital Airlines uses plastic food container.

All-Plastic Insulated Box

Reinforced plastic combined with plastic foam is used to make a box designed to keep airplane flight meals at 45° F. for periods up to 12 hours. Developed by Pynn-Hawley Co., both box body and door have foamed plastic cores covered by a tough skin of fibrous glass-reinforced Vibrin polyester resin, the latter material being a product of United States Rubber Co.'s Naugatuck Chemical division.

The box measures 30 by 30 inches, and is 36 inches deep. Interior equipment includes molded-in racks for 14 serving trays, plus a tray which holds three pounds of dry ice. With the exception of the door and ice tray, the box is molded in one piece. Newport Plastics, Inc., is the molder.

Readers' Service Item P-7

Pliofilm Food Packaging

A moistureproof plastic film for food packaging, which is not impervious to gas and shrinks to form a skin-tight covering around the product, has been introduced by Tee-Pak, Inc. Called Snug-Pak, the material is an oriented Pliofilm which shrinks upon being subjected momentarily to hot water or dry heat at 180-200° F.

Major use for the film will be by the meat industry to package hams, poultry, etc. Snug-Pak can also be used with frozen meats, since its excellent low-temperature properties prevent it from becoming brittle. Printed and unprinted roll stock is available in widths to 36 inches.

Readers' Service Item P-8

Picnic-style ham packed in Snug-Pak.

Plastic Flower Garden Pool

A fibrous glass-reinforced polyester pool for aquatic plants has been placed on the market by Production Plastics Corp. Designated Glaspool, the unit measures 4½ feet long by three feet wide. Two rectangular recesses are provided in the bottom, so that plants may be started in soil or gravel.

Reinforced Plastic Garden Pool.

No plumbing is required, installation is permanent, and maintenance is nil. Depth of the pool varies from 4-15 inches to accommodate plants of different root lengths. A blue-green color is incorporated into the pool itself, enabling it to harmonize with the surroundings. The polyester resin chosen for the application was Polylite, a product of Reichhold Chemicals, Inc.

Readers' Service Item P-9

Continuous Krene Vinyl Rolls

The first continuous plastic patent in continuous rolls to be produced in the United States has been introduced by Bakelite Co. Made of Krene vinyl film, this ladies' handbag and accessory material is marketed by Fabric Leather Corp.

Jet black in color, the patent features a dry uniformity of surface. The rolls are composed of two 30-yard sections placed face-to-face to prevent scratching. Sixty-yard rolls, 48 inches wide, are available in thicknesses of 16 18, and 20 mils.

Readers' Service Item P-10

New Literature

Write item numbers on Readers' Service card to obtain more information.

"Octylene Oxide." Bulletin No. 72. Becco Chemical Division, Food Machinery & Chemical Corp. 5 pages. Typical properties of this mixed, epoxidized diolefin are given along with a listing of its possible chemical reactions and suggested uses.

Readers' Service Item L-1

"Styron 429." Dow Chemical Co. 8 pages. In addition to describing the material and giving property data, this bulletin describes extrusion techniques, vacuum forming, and several finishing operations.

Readers' Service Item L-2

"Styron 689." Dow Chemical Co. 8 pages. This bulletin describes the material, lists properties and applications, and gives both injection molding and finishing considerations.

Readers' Service Item L-3

"Styron 440." Dow Chemical Co. 12 pages. A general description is included along with a listing of physical and chemical properties. Preheating, drying, injection molding, extrusion, vacuum forming, and finishing are given in some detail.

Readers' Service Item L-4

"C_{16}-C_{18} Olefin Oxide." Bulletin No. 74. Becco Chemical Division, Food Machinery & Chemical Corp. 5 pages. This mixed, epoxidized olefin contains a reactive epoxy group which undergoes a number of addition reactions to form solvents, stabilizers, surfactants, alkyd resins, and corrosion inhibitors. Typical properties are listed.

Readers' Service Item L-5

"Kel-F Plastic Printing Inks." M. W. Kellogg Co. 4 pages. These pigmented inks for marking, striping, and printing of non-adhesive and other difficult surfaces are of two distinct types; air drying and heat setting. The former type comprises a soluble fluorocarbon in a balanced solvent system; the latter are dispersed in a fugitive Kel-F oil and wax vehicle, and are intended for solvent and chemical resistant-applications.

Readers' Service Item L-6

"Compounding Plio-Tuf C-75 for Calendering." 55-194A. Goodyear Tire & Rubber Co. 2 pages. Compounds for processing are discussed, along with color pigments and fillers which can be used.

Readers' Service Item L-7

"Insulating & Jacketing Materials for Wire & Cable." WC-2. Polychemicals Department, E. I. du Pont de Nemours & Co., Inc. 12 pages. Wire coating techniques with Alathon, Rulan, and Zytel are described, including a discussion of extrusion equipment, the die, quench and take-off, and coloring.

Readers' Service Item L-8

"An Adventure in Profits." Mobay Chemical Co. 22 pages. This booklet, consisting essentially of illustrations, describes applications for urethane foams.

Readers' Service Item L-9

"Resin Adhesives." American Cyanamid Co. 50 pages. This booklet consists of indexed technical data sheets on the firm's Urac, Melurac, Cymel, and Woodwaste Binder resins used throughout the adhesives field. Properties and usages are described in detail.

Readers' Service Item L-10

"This Is Farrel-Birmingham." Farrel-Birmingham Co., Inc. 44 pages. This booklet describes and illustrates the company's design and manufacturing facilities at Ansonia, Derby, Buffalo, and Rochester.

Readers' Service Item L-11

"More Dependable, Economical, Flexible Central Hydraulic Systems." Bulletin 900. Greer Hydraulic, Inc. 8 pages. This bulletin explains how Greer hydro-pneumatic accumulators can reduce size, complexity, and operating costs of hydraulic molding equipment. Diagrams showing a weight-loaded system, hydraulic systems in fluid mediums, and an instantaneous squeeze-pressure system are included.

Readers' Service Item L-12

"Process Equipment." Bulletin 2[illegible] Dravo Corp. Short descriptions are g[illegible] for Dravo's intensive mixers, liquid bl[illegible] ers, kneading machines, pressure fil[illegible] ball mills, conical blenders, horizo[illegible] blenders, and pressure vessels. Facilities [illegible] the company plant are also described.

Readers' Service Item L-13

"The 'D' Series." Technical Bulle[illegible] #175. Claremont Pigment Dispersi[illegible] Corp. 7 pages. A description of how Cla[illegible] mont achieves heat and light stability, a[illegible] avoids migration and crocking with th[illegible] D-Series color pastes is contained in t[illegible] bulletin, together with a listing of the m[illegible] terials' properties.

Readers' Service Item L-14

"The 'K' Series." Technical Bulleti[illegible] #140. Claremont Pigment Dispersi[illegible] Corp. 6 pages. These data sheets list spec[illegible] fications for the firm's K-Series of stir-[illegible] calibrated color pastes for vinyl plastisol[illegible]

Readers' Service Item L-15

"The Askania Transometer." Bulleti[illegible] 301. Askania Regulator Co. 8 pages. Thi[illegible] illustrated bulletin describes the applic[illegible] tions and features of the machine, whic[illegible] comprises a positive displacement-type flo[illegible] meter and pneumatic signal transmitte[illegible] Ranges, specifications, and performanc[illegible] features are also listed.

Readers' Service Item L-16

"Rigid Unplasticized PVC Pipe, Fittings, and Valves." No. 13. Peter A. Frasse & Co., Inc. 8 pages. These data sheets cover physical properties, fabrication, corrosion resistance, and economies of the material, and list dimensions, operating pressures, and weights of the pipe available through Frasse. A procedure for solvent welding is included.

Readers' Service Item L-17

"See What It Can Do For Your Product." Rubatex Division, Great American Industries, Inc. 24 pages. An application booklet covering eight uses for the firm's vinyl foam.

Readers' Service Item L-18

"Extrusion of High-Gloss, High-Impact Styrene for Vacuum Forming." Extruderitems No. 4. Bakelite Co. 6 pages. A reprint of a paper by W. J. Canavan given at the Pacific Coast SPI Conference on the process and the materials used therein.

Readers' Service Item L-19

Book Reviews

"The Glasser's Manual." Art Whitehead and Berk Ericksen. Taylor & Art, Inc., Plastics, 1710 E. 12th St., Oakland 6, Calif. Paper, 5½ by 8½ inches, 40 pages. Price, $1.00.

The stated purpose of this work is to provide the home craftsman with a beginner's guide to plastic laminating. As such, the book begins with an explanation of the materials used, including glass cloth, epoxy and polyester resins, catalyst, epoxy-metal solder, thixatropic powder, and parting agents.

The steps involved in a wet lay-up are covered, and additional chapters are devoted to repairing, restyling, and building auto bodies; glassing boats; making furniture parts and art objects; and repairing with glass. Over 60 photographs and other illustrations are included.

"An Encyclopedia of the Chemical Process Industries." Jeffrey R. Stewart. Chemical Publishing Co., Inc., 212 Fifth Ave., New York, N. Y. Cloth, 6¼ by 9 inches, 820 Pages. Price, $12.00.

Raw materials, process, equipment, and finished products of the chemical process industries are listed in encyclopedic form. Commonly-encountered terms are defined, and the work contains thousands of trade-name and trade-marked products, together with the names of their manufacturers.

The expressed purpose of the book, based on the Fourth edition of "Stewart's Scientific Dictionary", is to provide authentic and practical information of interest to manufacturers, educational institutions, consumers, buyers, and others concerned with chemical materials. Definitions are not so technical or involved that the book would not be of service to a student or beginner in the industry.

"A Study and Evaluation of Kel-F Elastomer." R. E. Headrick, Wright Air Development Center. Order PB 111984 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 41 pages. Price, $1.25.

This work summarizes experimentation in compounding for low compression set and chemical resistance. Initial work with Kel-F revealed the most promising compounds to be those cured with benzoyl peroxide. Immersion tests in experimental hydraulic fluids indicate that the material may prove effective for aircraft hydraulic system applications at temperatures up to 400° F. Resistance to potential rocket fuels also was found with properly compounded Kel-F elastomers.

"Elastomeric Dithiopolyesters." F. W. Knobloch, Wright Air Development Center. Order PB 111949 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 25 pages. Price, 75¢.

Elastomers were prepared from a liquid polymer which, in turn, had been derived from a condensation product of mercaptoacetic acid and triethylene glycol. Two general types of elastomers are discussed; those obtained by reacting the polymer with organic and inorganic peroxides, and those in which the terminal mercapto groups reacted with unsaturated aldehydes.

"Evaluation of Organic Fluorine Compounds for Use in Military Aircraft." H. Rosenberg and J. C. Mosteller, Wright Air Development Center. Order PB 111983 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 22 pages. Price, 75¢.

Various fluorine compounds were tested and evaluated as fire-extinguishing agents, acid-resistant coatings and greases, nonflammable hydraulic fluids, elastomers, electronic equipment, and fungicides. Dibromodifluoromethane and bromotrifluoromethane have proved effective in extinguishing aircraft fires, particularly those involving rocket propellant mixtures. Polymers of monochlorotrifluoroethylene and tetrafluoroethylene have been used successfully as seals and gaskets, and in lubricants. Other compounds show promise as anti-wear additives for hydraulic fluids, as electronic components, and for protecting fabric against fungous attack.

"Development of an Improved Fungicidal Vinyl Coating for Cotton Fabric." R. R. Heitkamp, W. J. Dewar, and D. D. Eichorn, Flexfirm Products, for Wright Air Development Center. Order PB 121020 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 46 pages. Price, $1.25.

This report evaluates secondary plasticizers and extenders according to their ability to impart fungistatic properties to vinyl coatings. Evaluations were carried out by determining the tensile strength of coated fabric samples before and after two weeks of soil burial. Only one, dehydroabietylammonium pentachlorophenoxide, satisfied all the requirements in providing protection from microbial attack and at the same time giving the formulator leeway with respect to color range. Some secondary plasticizers were found to have limited effectiveness where heavy coatings can be tolerated.

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Typical Analysis
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Thru	On	%
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Abstracts of Important Articles

Materials

"Isophthalic in Plastics," R. W. Stephenson, *Western Plastics,* 3, 4, 16 (April 1956).

This paper, presented at the SPI Pacific Coast Conference in March, describes the uses of isophthalic acid in reinforced plastics, saturated polyesters, polyamides, and plasticizers.

"Statistics Shorten Structural Plastics Testing," T. J. Gair, P. E. Thompson, and M. H. Monahan, *Plastics World,* 14, 5, 16 (May 1956).

Use of the statistical approach to the evaluation of a structural plastic by flexural testing is shown to greatly reduce testing time, money, and effort.

"Effect of Corona on Plastic Laminates," A. Rufolo and R. R. Winans, *ASTM Bull.,* No. 214, 51 (May 1956).

A method of corona exposure and exposure effects on various properties of plastic laminates are presented as a basic approach to the problem of corona deterioration in electrical equipment.

"A New Measure of Plastic Moldability," D. B. Semeyn, *SPE J.,* 12, 5, 15 (May 1956).

Discussion of a set of systematic tests developed at Dow Chemical Co. for establishing a rating of moldability of various plastic materials. This rating or "Moldability Number" is obtained by dividing minimum cycle time into molding area number. This paper was presented at the SPE Conference in January, and the article includes the discussion which followed the talk.

"Characteristics of Biaxially Stretch-Oriented Acrylics," D. A. Hurst, *SPE J.,* 12, 5, 18 (May 1956).

The characteristics of biaxially stretch-oriented acrylics are shown to depend on the degree of stretching and, to a lesser extent, on the manner of stretching. The acrylic materials discussed are those used in aircraft canopies. This paper was presented at the SPE Conference in January.

"Metal-Bonding Adhesives for High-Temperature Service," J. M. Black and R. F. Blomquist, *Modern Plastics,* 33, 10, 225 (June 1956).

Results are given of an investigation to develop a metal-bonding adhesive with improved heat-resistant properties. The formulation has high resistance to aging at 550° F., and is promising for bonding sandwich constructions. A straight epoxy adhesive with superior strength properties at 250-300° F. also is reported.

"Silicone Alloys—New Engineering Materials," C. L. Petze, Jr., *Modern Plastics,* 33, 10, 207 (June 1956).

Alloys of silicones with other polymers show outstanding ability to retain their mechanical and electrical properties during long exposure to weather and sea water.

"Polyamide-Epoxy Resins," D. E. Floyd, W. J. Ward, and W. L. Minarik, *Modern Plastics,* 33, 10, 238 (June 1956).

Properties of polymers formed by the interaction of polyamides and epoxy resins are described, and data are given relative to their use in coatings, adhesives laminates, tools, and potting compounds.

"Protective Coatings for Polystyrene," J. A. Snyder, C. F. Martino, J. R. Wilkinson, and E. H. Wood, *Modern Plastics,* 33, 10, 252 (June 1956).

Results are given to show the improvement in weathering obtained by the application of a good coating to polystyrene.

"Definitive Specifications for Plastics Materials," W. C. Wall and R. E. Brooks, *SPE J.,* 12, 5, 28 (May 1956).

The role of specifications in assuring receipt of the proper plastic material for each application. A military specification is described as to objectives, organization, and preparation.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines will be printed here quarterly.

The next complete listing will appear in September.

—The Editor

"Influence of Flow Orientation and Injection Temperature on the Strength of Injection Moldings," R. A. Horsley and D. J. A. Lee, *Brit, Plastics,* 29, 4, 134 (Apr. 1956).

This article describes some measurements of the strengths of two different types of moldings; one a thin, square plaque gated so as to produce a parallel flow pattern, and the other a conventional quarter-inch thick test bar.

"Measuring the Hardness of Plastics," W. Gohl, *Kunststoffe,* 46, 4, 139 (Apr. 1956).

No really useful method of hardness testing has been standardized as yet. The five-millimeter ball is shown to be the most useful means of hardness testing, and a simple method is described which yields a definite hardness value for almost all plastics.

"Determination of Gas Permeability of Plastics Films by Means of the Measurement of Change of Pressure and Volume. I—Accuracy and Sensitivity of the Method," W. Schrufer, *Kunststoffe,* 46, 4, 143 (Apr. 1956).

The accuracy of three instruments for determining gas permeability of plastic films was investigated by experimentation. Results were found to agree within narrow limits with the calculated accuracy.

"Loss of Substance of Organic Insulators," C. Reimer, *Kunststoffe,* 46, 4, 149 (Apr. 1956).

Several types of insulating materials were studied to obtain a picture of the progressive loss in weight, in terms of duration and temperature.

"Chlorinated Phenol Ethers," O. Pesta and F. Sinwel, *Kunststoffe,* 46, 4, 155 (Apr. 1956).

A number of ethers of higher chlorinated phenols were investigated. It was found that some members of this group serve not only as extenders, but also as true plasticizers. Work to date indicates that these ethers are suitable for use in PVC electrical compounds and PVC pastes.

"Improved Polyvinyl Chloride Pastes," G. Wick and G. Weber, *Kunststoffe,* 46, 5, 199 (May 1956).

A brief survey of PVC pastes and applications.

"Electrostatic Charges on Polyvinyl Chloride," B. D. Sully, *Brit. Plastics,* 29, 3, 103 (March 1956).

This article covers the mechanism of charge separation, the explosion hazard, apparatus for detection of an electric charge, distribution of the charge on plastics, electrostatic effects, and the use of chemical anti-static agents.

"Fire-Resistant Properties of PVC and Related Polymers," S. J. Skinner and S. E. Bolam, *Rubber & Plastics Age*, 37, 3, 169 (Mar. 1956).

PVC types and their processing, extrusion, and compounding for fire resistance are discussed.

"Laminates of Vinyls to Rigid Materials," W. De C. Crater, *Rubber & Plastics Age*, 37, 5, 309 (May 1956).

An SPI film, Sheeting, and Coated Fabrics Division paper (1955), this article describes the Marvibond Process for laminating vinyls to metals and other rigid materials.

"A New Method of Measuring the Characteristic Mechanical Behavior of High Polymers," W. Voight, *Kunststoffe*, 46, 2, 58 (Feb. 1956).

Testing of plastic films is currently being done mainly with tensile testers, most of which do not give constant rate of loading. A simple device is described which permits measurements to be performed under constant load, constant rate of loading, and constant rate of extension with variable temperatures.

Equipment

"Extruder Dies. I—Dies for Tubing and Crossheads. II—Blow Extrusion, Wide Sheet, and Multi-Color Profiles." G. Schenkel, *Kunststoffe*, 46, 4, 176 (Apr. 1956); 46, 5, 221 (May 1956).

Basic features of the most important types of dies are discussed, together with the advantages, limitations, rheological principles, and performance of the worms.

"Hydraulics in the Construction of Injection Molding Machines," A. Blumer, *Brit. Plastics*, 29, 3, 108 (March 1956).

Types of injection machine drives are discussed and compared, and the hydraulic drive is shown to be superior to pneumatic and mechanical drives.

"Use of Photo-Electronic Equipment in the Plastics Industry," L. Walter, *Brit. Plastics*, 29, 4, 142 (Apr. 1956).

Photo-electronic equipment is used for controlling sheet thickness, counting, automatic batching, inspection of bottle cap liners, and cycling of hydraulic molding presses.

"Continuous 'Imposed-Order' Mixer-Extruder with Complementary Adjustability," M. S. Frenkel, *Brit. Plastics*, 29, 2, 62; 29, 3, 98 (Feb. & March 1956).

A new principle of mixing is described. This principle is based on the essential requirements of the mixing process, and should have a fundamental impact on the design of mixers, extruders, and crushers. General requirements and basic construction are discussed in the first part of the article, and more specific applications are covered in the second part.

"The Principle of the Potential Convergence-Divergence as Foundation for Research in Different Fields," M. S. Frankel, *Brit. Plastics*, 29, 5, 184 (May 1956).

A further discussion and development of the principle described in the author's previous articles on the mixer-extruder.

"Multi-Screw Extruders," K. Baigent, *Trans. Plastics Inst.*, 24, 56, 134 (Apr. 1956).

This paper discusses screw functions and drives, the extrusion path of the polymer, and screw efficiency of multi-screw extruders and their application to difficult extrusions.

"Single-Screw Extruders," E. G. Fisher, *Trans. Plastics Inst.*, 24, 56, 125 (Apr. 1956).

Applications of single- and multi-screw extruders are compared, and information given on the design, flow type, factors affecting output, screw construction and characteristics, and other design factors of single-screw machines.

Processing

"Effect of the Addition of Paraffins with High Melting Points to Polyethylene in the Manufacture of Hollow Moldings," G. Benthin, *Kunststoffe*, 46, 3, 135 (March 1956).

Among other products, the Fischer-Tropsch process with iron catalysts under pressure yields hard paraffins which can be added to polyethylene in all proportions. Adding 10-20% of such paraffins to high-pressure polyethylene improves its hardness and increases its impermeability to water vapor, gases, and aromatic compounds.

"Injection Molding Research, Today and Tomorrow," J. Eveland, H. J. Karam, and C. E. Beyer, *SPE J.*, 12, 5, 30 (May 1956).

Present and future methods which can be employed to improve control of plastic pressure during injection molding. These methods involve control of pressure within the cavity; control and loss of pressure in the heating cylinder; transmission of pressure through the fluid zone of the heating cylinder; and equalization of pressure throughout the cavity.

"Trapped-Sheet Forming," E. T. Aldington, P. S. Rath, and A. M. Tobia, *Modern Plastics*, 33, 7, 117 (March 1956).

A new technique of forming transparent cover-all closures for food containers solves the problem previously posed by the plastic memory of oriented styrene sheet.

"Injection Molding of Vinyl Chloride Dry Blends," C. W. Bulkley, *SPE J.*, 12, 2, 14 (Feb. 1956).

Molding techniques are similar to those of other thermoplastics, but cycles and temperatures must be controlled carefully. Variations in formulation must be taken into consideration in the molding process. Devices such as the Monsanto adjustable nozzle restriction and the Hendry Screw Preplasticizer have been used to great advantage in producing injection molded PVC dry blend products of excellent quality.

"Plug-Assist Forming," J. W. Mighton, *SPE J.*, 12, 6, 83 (June 1956).

A discussion of the plug-assisting method of forming plastic parts which permits the forming of deeper, stronger parts that are structurally practical with conventional forming techniques.

Application

"Reinforced Plastics in Aircraft and Guided Missiles," W. E. Braham, *SPE J.*, 12, 6, 87 (June 1956).

A generalized discussion of the role played by reinforced plastics in aircraft and guided missile design.

"Polyester Laminates — Fire Resistant Electrical Grade," J. K. Allen, *SPE J.*, 12, 6, 30 (June 1956).

Results of an investigation of fire-resistant, electrical-grade polyester laminates made with chlorine combined into the polyester molecule, chlorinated hydrocarbons as fillers, and mineral compounds as fillers.

"Structural Adhesives for Use at Elevated Temperatures," D. W. Elam and J. L. Morrill, *Western Plastics*, 3, 3, 21 (March 1956).

Adhesives developed for military applications are discussed. These adhesives can be expected to find their way into civilian applications, particularly in honeycomb sandwich constructions.

General

"From Jets to Jewels," Betty Lou Raskin, *Chem. Eng. News*, 34, 21, 2492 (May 21, 1956).

A review of foamed plastics, including their methods of manufacture, properties, and typical applications.

"Polyethylene—Past and Future," G. W. Jargstorff and G. F. Kirkpatrick, *SPE J.*, 12, 6, 25 (June 1956).

Originally presented at the SPE Conference in January, this paper reviews the growth of polyethylene in the past and its potentials for the future.

Patent Digest

Materials

Vinyl Ester Copolymers. No. 2,740,771. Raymond I. Longley, Jr., and Earl C. Chapin, Springfield, and Richard F. Smith, Ludlow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

The vinyl ester of an aliphatic unsubstituted acid is polymerized with 2-butene-1,4-diol. The resulting copolymer should contain 1-15% hydroxyl groups by weight.

Styrene-Modified Polyvinyl Acetate Resins. No. 2,741,650. John Charles Lukman and Ora Leon Wheeler, Agawam, Mass. (to Shawinigan Resins Corp., Springfield, Mass.).

The heat reaction product of 50-150 parts of a mixture of PVA and styrene, 100 parts of water, and 0.5-6 parts of a water-soluble, hydrophilic colloid.

Synthetic Resins Formed by Heating Together a Phenol-Terpene Resin with a Phenol Aldehyde Resin. No. 2,741,651. Jerome Been and Martin M. Grover, Rutherford, N. J. (to Rubber & Asbestos Corp., Bloomfield, N. J.).

Phenol is reacted with a terpene hydrocarbon, and the resulting preformed resin is then heated with a heat-hardening resin which, in turn, is formed by a para-hydrocarbon-substituted phenol with an excess of methylene-releasing agent.

Production of Copolymers. No. 2,741,652. Alfred L. Miller, Roselle, N. J. (to Celanese Corp. of America, New York, N. Y.).

Aqueous tertiary butanol is copolymerized with 32 parts by weight of acrylonitrile, 8 parts by weight of N-cyclohexylacrylamide, 1 part by weight of potassium persulfate, and 0.5 part by weight of sodium metabisulfite for a period of 20 hours. Reaction temperature is 45° C., and the amount of butanol is 30% by volume.

Dyeable Nitrogen-Containing Polyesters. No. 2,739,958. James Lincoln and Kathleen Mary Hammond, London, and Walter Henry Groombridge, Spondon, near Derby, England (to British Celanese, Ltd., Great Britain).

High-melting, crystalline, aromatic polyesters are obtained by condensing free glycol and a simple ester of terephthalic acid in the presence of N:N-di-(beta-hydroxyethyl)-aniline. This produces a polymer with a nitrogen content of 0.25-0.45% by weight.

Manufacture of Perhalocarbon Polymers. No. 2,739,960. Albert L. Dittman, Jersey City, N. J. (to M. W. Kellogg Co., Jersey City, N. J.).

Trifluorochloroethylene, prepared by the dechlorination of trichlorotrifluoroethane in the presence of methyl alcohol, is polymerized in the presence of a high-boiling solvent and a promoter.

Preparation of Finely-Divided Cellulose Plastics. No. 2,740,723. Robert S. Voris, Arden, Del. (to Hercules Powder Co., Wilmington, Del.).

A cellulose lacquer in a water-immiscible, volatile solvent is emulsified in water and sprayed into a heated, gaseous medium. This vaporizes the liquid, and produces a dry powder of solid and hollow spheroids. They are then suspended in a non-solvent medium, creating a suspension-type coating composition.

Modified Melamine-Formaldehyde Resin. No. 2,740,736. Curtis Elmer and Thomas Anas, Springfield, and Stuart H. Rider, Longmeadow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

The material is a co-condensation product of one mol of melamine, 2-4 mols of formaldehyde, and 0.0006-0.006 mol of ammeline, ammelide, or cyanuric acid.

Melamine - Formaldehyde Laminating Syrup. No. 2,740,737. Curtis Elmer and Thomas Anas, Springfield, and Stuart H. Rider, Longmeadow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

A co-condensation product of one mol melamine, 2-5 mols formaldehyde, 0.1-1 mol toluene sulfonamide, and 0.0006-0.006 mol ammeline, ammelide, or cyanuric acid.

Melamine-Aryl Guanamine Resins. No. 2,740,738. Curtis Elmer and Thomas Anas, Springfield, and Stuart H. Rider, Longmeadow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

One mol of melamine is condensed with 2-5 mols of formaldehyde, 0.05-0.3 mol of aryl or aralkyl guanamine, and 0.0006-0.006 mol of ammeline, ammelide, or cyanuric acid.

Method for Preparing Interpolymers of Vinylidene Cyanide with Aliphatic Conjugated Diolefins. No. 2,740,770. Harry Gilbert, Cuyahoga Falls, and Floyd F. Miller, Wadsworth, O. (to B. F. Goodrich Co., New York, N. Y.).

Vinylidene cyanide and an aliphatic, conjugated diene are polymerized in a water-free medium, and in the presence of 0.01-5% of an organic thiol and a strong, inorganic acid.

Method for Preparing Interpolymers of Vinylidene Cyanide with Aliphatic Conjugated Diolefins. No. 2,740,769. Harry Gilbert, Cuyahoga Falls, and Floyd F. Miller, Wadsworth, O. (to B. F. Goodrich Co., New York, N. Y.).

Vinylidene cyanide and an aliphatic, conjugated diene are polymerized in a water-free medium, and in the presence of 0.002-5% of an organic thiol and sulfur dioxide.

Production of Polyesters Using Basic Ferric Acetate as Catalyst. No. 2,740,768. John K. Sullivan, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

In preparing polyesters by self-condensation, a catalytic amount of basic ferric acetate is employed to remove the glycol and also initiate the reaction itself.

Modification of Coumarone-Indene Resins with Formaldehyde. No. 2,740,767. Frederick W. Breuer and Burt F. Hoffreth, Manheim Township, Lancaster County, Pa. (to Armstrong Cork Co., Lancaster, Pa.).

Coumarone-indene resins with a ring-and-ball softening point below 18° C., and a mixed cloud point below 0° C., are upgraded by heating in the presence of a formaldehyde-yielding substance and an acid catalyst.

Method of Making Synthetic Resin Foam Structures. No. 2,740,743. Henry A. Pace, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

A foamable, unsaturated alkyd resin is admixed with styrene, dinitrosopentamethylenetetramine, and an organic peroxide polymerization catalyst. An organic diisocyanate is dispersed in the mixture, and the material heated to 50° C.

Furan Resin-Tall Oil Reaction Product. No. 2,735,826. Raymond M. Frey, Milwaukee, Wis. (to McGraw Electric Co., Milwaukee, Wis.).

A polymerized material is obtained by reacting a mixture of tall oil, furfural, and furfuryl alcohol in predetermined proportions.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Equipment

Equipment for Making Elongated Shapes from Polyamides. No. 2,736,057. William J. Davis and Robert B. Koch, Reading, Pa. (to Polymer Corp., Reading, Pa.).

The equipment comprises an open-end forming tube lined with polytetrafluoroethylene, a feeder, and a temperature-regulating element mounted upon the tube and capable of lengthwise movement.

Extrusion Press Attachments for Extruding Profiles, Tubes, and Other Similar Products. No. 2,741,363. Peter Billen, Leverkusen-Kuppersteg, and Walter Haendeler, Dusseldorf, Germany. (to Schloemann Aktiengesellschaft, Dusseldorf, Germany).

A wire-guiding means defines a continuous die orifice, limiting the shape and wall thickness of the body to be produced. Reinforcing wires are united with the extruded material in a continuous chamber of greater cross-sectional area than the orifice. Pressure draws the wires through the orifice within the wall structure of the body.

Extruders. No. 2,740,989. George E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

The extruder comprises an elongated, horizontally-extending extrusion cylinder with a plurality of branch conduits extending transversely from one end. A number of extruding heads with T-shaped passages connect to the conduits. A rotatably-mounted extension screw advances the plastic material along the cylinder under pressure, and communicates with the cylinder to provide plasticizing action.

Plasticating Torpedo for Plastics Die Expressing Machines. No. 2,740,160. Robert B. McKee, Jr., and Carlton E. Beyer, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

The torpedo is coaxial with the barrel, and is located between the forwarding means and the outlet. It consists essentially of an axial core with a relatively small diameter, and with a plurality of rigid radial fins of zero pitch. These fins are all in metallic contact with the barrel, and are arranged in offset position relative to each other.

Extruders. No. 2,740,158. Grant S. Brown, Downers Grove, Ill. (to Western Electric Co., Inc., New York, N. Y.).

The extruder comprises a hollow head, a tubular-core tube holder with socket mounted in the passage arms, a core tube with lugs projecting outwardly, a tube lock with lugs for engaging the core tube lugs, and a means for turning the core tube on its axis.

Apparatus for Applying Plastic Sheeting to Metal Plates. No. 2,732,880. Watson L. Hawk, Richmond, Calif. (to Rheem Mfg. Co., Richmond, Calif.).

The apparatus includes a frame, plate support, laminating roller, rotating means, axially-extending slot, radially-movable cutting element, releasing means, and a suction force.

Processing

Melamine Purification. No. 2,734,059. Richard W. Hamilton, Darien, and William C. Mallison, Noroton, Conn. (to American Cyanamid Co., New York, N. Y.).

A slurry of crude melamine is formed in an aqueous, saturated melamine solution. This slurry is then subjected to a cyclone classification operation, and the overflow fines of essentially purified melamine are collected. They are subjected to an alkaline wash and air-dried.

Stretching and Laminating Thermo-Stretchable Film. No. 2,740,741. Paul J. Vaughan, Cuyahoga Falls, and Norman W. Hockett, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Adhesive is applied to the surface of the film or the sheet material, and both are moved through the bite of pressure rolls. The film is applied over a feed roll which, however, has a slower surface speed than the pressure rolls. Heat is applied to soften the film as it enters the pressure rolls, causing it to stretch substantially during lamination.

Process of Coating a Resin-Impregnated Support Sheet with a Melamine-Formaldehyde Composition and Resulting Product. No. 2,739,081. Henry P. Wohnsiedler, Darien, and Walter M. Thomas, Springdale, Conn. (to American Cyanamid Co., New York, N. Y.).

A plasticized resin suspension is prepared by blending a soluble melamine-formaldehyde compound and a plasticizer on heated differential rolls until the composition is rendered insolubilized but fusible. The plasticized resin is then milled with an aqueous solution of a volatile, water-soluble monohydric alcohol until a paste-like suspension is produced. This material is spread over a support sheet, which has been impregnated with a thermosetting resin. Heat and pressure are then applied to render the surface laminate infusible.

Process for Sizing Paper with Polyethylene. No. 2,739,058. Denis J. O'Flynn and Donald G. Pye, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

Lignocellulosic fibers in the beater stage of paper manufacture are subjected to the action of ethylene homopolymer in the form of submicroscopic particles, which have been colloidally dispersed in an aqueous medium.

Stretching of Film Followed by Lamination. No. 2,740,742. Paul J. Vaughan, Cuyahoga Falls, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Thermoelastic film which is at least five mils thick, and a sheet which has dimensional stability in the presence of heat, are laminated by means of an adhesive and pressure rolls. The film is heated to soften, and stretched at least 100%. Heat is maintained until annealing has taken place, at which time the film loses its tendency to shrink.

Applications

Method for Imbedding a Hollow Needle in Plastic Material. No. 2,740,192. Robert W. Ogle, Pasadena, Calif.

A hypodermic needle is affixed to an imperforate portion of a plastic needle hub, which is molded integrally with a plastic syringe barrel. A mandrel of a diameter sufficient to prevent core formation telescopically through the bore of the needle is inserted, and the needle itself is thrust into the hub to a predetermined extent. The mandrel is withdrawn when the plastic material has set.

Multiple Size Polyethylene Shoe Shaping Counter. No. 2,738,600. Edward L. Schultz, Endicott, N. Y. (to Endicott-Johnson Corp., New York, N. Y.).

The counter is made of solid, flexible polyethylene, and is generally U-shaped with two sides diverging outward from their connected portions. An inturned, substantially flat, horizontal heel-seat flange is formed integrally with the lower end of the upright side wall. This wall has a vertically-concave inner surface, a vertically-convex outer surface, and tapers in thickness toward the outer wall. The flange is formed with a plurality of V-shaped notches extending from the edge.

Cervical Brace. No. 2,736,314. Randall H. Hale, Los Angeles, Calif.

The appliance comprises a chin cup, an occipital part, anterior and posterior sections, all of light-transmitting thermoplastic material. These present a front sheet to their respective parts, and have backing pads which protrude beyond the edges. Separate adjustable straps connect the chin cup and the occipital part on each side of a patient's neck, and detachable straps connect anterior and posterior portions.

Method of Packaging. No. 2,736,656. John M. Marshall, Patchogue, N. Y. (to Kraft Foods Co., Chicago, Ill.).

Individual food servings are packaged in formed, elongated thermoplastic strips in the shape of cups with horizontally-extending border flanges. A second thermoplastic strip is applied as a cover, and the edge heat sealed along the border flange. A portion extends over to provide a finger grip for peeling.

Current Market Prices

Price Changes and Additions

Coating Resins

Synvaren 631	lb.	.18 /	.215
PLS-1	lb.	.455 /	.49
PLS-2	lb.	.42 /	.455
PLS-22	lb.	.415 /	.45
PLSA	lb.	.57 /	.605
PLSAA	lb.	.745 /	.78
PLSR	lb.	.775 /	.81

Plasticizers

Columbian Carbon butyl stearate	lb.	.2275/	.315
Capryl alcohol	lb.	.195 /	.30
Caprylene	lb.	.10 /	.205
Dibenzyl sebacate	lb.	.88 /	.965
Dibutyl phthalate, dihexyl phthalate	lb.	.30 /	.395
Dibutyl sebacate, CP	lb.	.64 /	.725
Dicapryl phthalate	lb.	.295 /	.38
Dicapryl sebacate, dioctyl sebacate	lb.	.58 /	.665
Dihexyl adipate	lb.	.40 /	.495
Dihexyl sebacate	lb.	.62 /	.705
Diisooctyl phthalate, dioctyl phthalate	lb.	.305 /	.40
Dimethyl sebacate	lb.	1.25 /	1.335
Harchemex	lb.	.24 /	.345
Harflex 300	lb.	.58 /	.675
325	lb.	.4325/	.52
500	lb.	.315 /	.41
Methyl hexyl ketone	lb.	.26 /	.365
Sebacic acid, CP	lb.	.70 /	.82
Purified	lb.	.64 /	.76

Resins & Molding Compounds

Phenolic

Resinox molding compounds:			
Gen. purpose & heat resist	lb.	.205 /	.215
Impact	lb.	.255 /	.3225
Low elec. loss	lb.	.31 /	.365
Special grade	lb.	.215 /	.255
Rogers phenolic molding compounds:			
RX 425	lb.	.29 /	.295
Special colors	lb.	.34 /	.405
RX 428	lb.	.355 /	.36
Special colors	lb.	.42 /	.465
RX 429	lb.	.365 /	.37
Special colors	lb.	.395 /	.48
RX 431	lb.	.4125/	.4175
Special colors	lb.	.455 /	.55
RX 438	lb.	.4675/	.4725
RX 441, 455	lb.	.32 /	.325
RX 442	lb.	.3475/	.3525
RX 447	lb.	.5025/	.51
RX 448	lb.	.355 /	.36
RX 458	lb.	.38 /	.385
RX 469	lb.	.365 /	.37
RX 470, 480	lb.	.40 /	.405
RX 478, 488	lb.	.425 /	.43
RX 525, 545	lb.	.29 /	.295
RX 530	lb.	.4125/	.4175
Special colors	lb.	.42 /	.475
RX 547	lb.	.37 /	.375
RX 625	lb.	.395 /	.40
RX 628	lb.	.455 /	.46
Synvar molding compounds, PM series	lb.	.205 /	.2625
Synvaren 640	lb.	.30 /	.335
920	lb.	.21 /	.245
935	lb.	.195 /	.23
9203, 9203A	lb.	.173 /	.208
Synvaren liquid industrial resins:			
675	lb.	.29 /	.325
920	lb.	.21 /	.245
CP-66	lb.	.19 /	.225
PBL-2	lb.	.33 /	.365
PBL-218S	lb.	.27 /	.305
Synvarite GW-1000	lb.	.34 /	.36
GW-1080, PBL-108F, PBL-718	lb.	.37 /	.39
GW-2400	lb.	.375 /	.395
PBL-100	lb.	.31 /	.33
PBL-108FF	lb.	.38 /	.40
PBL-210, PBL-3301	lb.	.36 /	.38
PBL-410	lb.	.33 /	.35
PBL-3311	lb.	.35 /	.37
PNL-12HL/11, PNL-156HL/24	lb.	.3025/	.3225
PNL-159H, PNL-169H	lb.	.29 /	.31
PNL-169PD, PNL-179PD	lb.	.28 /	.30
PNL-355PD	lb.	.315 /	.335
PNL-1279HL	lb.	.2875/	.3075
PT	lb.	.32 /	.34

Styrenes

Cycolac compounds:			
Natural powders	lb.	.58 /	.66
Natural & std. color pellets	lb.	.65 /	.73

Stabilizers

Vanstay C-73, S	lb.	.63 /	.65
HT	lb.	.90 /	.92
L	lb.	.33 /	.35
N	lb.	.98 /	1.00
R	lb.	.70 /	.72
Z	lb.	.67 /	.69

News from Abroad
(Continued from page 544)

German exports of plastics materials in 1955 showed gains of 43% in volume and about 36% in value over 1954 levels. The 1955 export total was 87,531 tons, valued at 297,609,000 DM. Of this total volume, approximately 66% consisted of polymerization products, 21% were condensation products, and 13% were cellulosic materials. Western Europe, including Great Britain and Scandinavia, was the major market for these exports, while Argentina and Chile were the leading Latin American customers. Exports to the U. S. in 1955 amounted to 10,743,000 DM, less than 4% of the German total.

Exports of articles made of plastics in 1955 totaled 153,211,000 DM, an increase of nearly 40% over the previous year and about 16% of total sales in 1955.

Imports of plastics materials in 1955 totaled 20,293 metric tons valued at 55,067,000 DM, as compared with 17,870 tons and 67,401,000 DM in 1954. The U. S. was the largest supplier of polymerization materials in 1955, supplying 2,456 tons of a total of 12,967 tons imported. The U. S. also supplied the largest amount of cellulosics, 952 tons of a total of 2,680 tons imported. The U. S., Great Britain, and Italy are the major suppliers of polymerization materials to Germany.

The outlook for plastics in West Germany indicates extensive growth. Further production increases equaling those of 1955 are anticipated for this year in both materials and products, with polymerization products expected to predominate.

New French Polystyrene

Styrene is a new polystyrene recently put on the market by the Societe Resines et Vernis Artificiels. It is produced by a process which utilizes heat exclusively for polymerization, thus avoiding the introduction of the suspension agents and catalysts usually employed in systems treating aqueous dispersions. This permits a continuous, bulk production method which is claimed to yield a transparent, colorless polystyrene of exceptional beauty in appearance, stability, and a high degree of purity. Because of strictly controlled production, greater uniformity of properties can be guaranteed than is possible with any other manufacturing process. Styvarene is available in standard grades, and also as Styvarene Choc for use in articles which have to withstand mechanical stress.

Names in the News
(Continued from page 547)

J. H. Pierce has been promoted to manager of Styrofoam sales for the plastics department of Dow Chemical Co., Midland, Mich. He replaces **Robert L. Curtis** who has resigned from the firm. With Dow since 1948, Mr. Pierce was sales supervisor for general chemicals in the Camden, N. J., office.

J. R. Akers has been appointed manager of the flexible packaging materials division of Bakelite Co., New York, N. Y. He succeeds **T. W. Sharp** who has been named manager of the company's industrial products department. In his new post, Mr. Akers will be responsible for both consumer and industrial product packaging sales of flexible plastics.

Jim J. Orr has been appointed assistant director of engineering for United States Rubber Co., New York, N. Y. He joined the company in 1931 as an electrical engineer in central engineering, served as plant engineer at Providence, R. I., and was formerly manager of plant engineering in the central engineering department.

A. G. Hewitt has been named vice president in charge of research and development for The Visking Corp., Chicago, Ill. He formerly served as general manager of the firm's food casing division, and as a vice president.

B. J. Manno has been appointed eastern sales representative for the plastic division of O'Sullivan Rubber Corp., Winchester, Va. Based in offices at Hawthorne, N. J., he will be responsible for sales of Sullvyne-Clad metal-vinyl laminate.

John J. Jungbauer has been appointed division engineer for reinforced plastics by Minnesota Mining & Mfg. Co., St. Paul, Minn. He joined the firm in 1945 as a project engineer; became director of tape development engineering in 1953; and has been responsible for the engineering phase of 3M's reinforced plastics since their inception, and for engineering on plastic pipe since last January.

(Continued on page 562)

Domestic Production and Sales of Plastics and Resin Material, March and April, 1956

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of March and April, 1956. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

All materials show a slight dropping-off, attributable largely to the anticipated summer lag. The one exception is styrene, which shows an approximate 3-million pound gain.

	March		April	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,901,079	1,790,061	1,544,763	1,659,595
Sheets, 0.003 gage and over	1,639,009	1,534,662	1,398,121	1,264,825
All other sheets, rods, and tubes	755,866	735,702	663,561	625,461
Molding and extrusion materials	8,006,700	8,078,200	7,376,371	7,076,539
Nitrocellulose sheets, rods, and tubes	500,752	487,284	512,854	470,667
Other cellulose plastics	585,417	639,295	429,114	356,405
TOTAL	13,388,823	13,265,204	11,924,784	11,453,492
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	20,351,168	17,023,536	20,609,235	17,616,322
Bonding and adhesive resins for—				
Laminating (except plywood)	6,217,508	4,454,157	5,070,957	3,458,330
Coated and bonded abrasives	1,318,262	1,387,724	1,509,268	1,547,011
Friction materials (brake linings, clutch facings, and similar materials)	1,936,105	1,734,738	1,663,360	1,644,050
Thermal insulation (fiber glass, rock wool)	4,710,665	4,667,757	4,742,959	4,478,868
Plywood	4,059,936	3,254,965	3,746,510	2,932,613
All other bonding and adhesive uses	2,772,062	2,783,492	2,835,023	2,957,337
Protective-coating resins, unmodified and modified except by rosin	2,578,165	2,346,772	2,673,802	2,198,841
Resins for all other uses	2,569,204	2,253,877	2,629,433	2,073,524
TOTAL	46,513,075	39,907,018	45,480,547	38,906,896
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	4,081,338	2,632,638	3,887,267	2,742,259
Paper-treating and paper-coating resins	1,446,578	1,873,086	2,321,262	2,093,767
Bonding and adhesive resins for—				
Plywood	9,239,321	8,172,091	8,169,467	8,363,919
All other bonding and adhesive uses, including laminating	2,018,807	1,880,948	1,877,546	1,666,375
Protective-coating resins, straight and modified	2,985,765	2,032,202	3,708,570	2,534,698
Resins for all other uses, including molding	8,374,614	7,454,247	7,104,102	5,778,909
TOTAL	28,146,423	24,045,212	27,068,214	23,179,927
Styrene Resins:				
Molding materials[1]	34,869,361	36,169,252	40,172,330	40,585,443
Protective-coating resins, straight and modified	8,825,092	8,475,312	7,698,851	7,780,713
Resins for all other uses	8,403,105	8,649,369	8,639,466	9,170,161
TOTAL	52,097,558	53,293,933	56,510,647	57,536,317
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		7,388,429		6,247,472
Sheeting (resin content)		5,279,948		4,674,168
Molding and extrusion (resin content)		16,964,803		15,560,437
Textile and paper treating and coating (resin content)[3]		4,961,913		4,646,341
Flooring (resin content)		5,015,556		4,493,648
Protective coatings (resin content)		2,273,656		2,343,848
All other uses (resin content)		5,810,627		7,294,885
All other vinyl resins for—				
Adhesives (resin content)		3,161,888		3,113,594
All other uses (resin content)		9,364,277		11,611,810
TOTAL	66,675,061	60,221,097	65,487,045	59,986,203
Coumarone-Indene and Petroleum Polymer Resins	22,061,334	21,302,458	20,343,944	20,169,912
Polyester Resins	5,986,452	5,044,737	5,854,567	5,777,502
Polyethylene Resins	40,566,614	42,187,469	42,205,117	38,782,882
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1,4]	3,922,247	3,443,438	3,371,774	2,822,310
Protective-coating resins[5]	901,612	416,269	697,171	388,691
Resins for all other uses[6]	9,906,406	9,373,772	10,530,440	9,482,373
TOTAL				
GRAND TOTALS	290,165,605	272,500,607	289,474,250	268,486,506

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.

CALENDAR of COMING EVENTS

September 16-21
American Chemical Society's 130th National Meeting. Atlantic City, N. J.

September 17-21
Second Pacific Area National Meeting, American Society for Testing Materials. Hotel Statler, Los Angeles, Calif.

September 19
SPE New York Section. Gotham Hotel, New York, N. Y.

September 26
Reinforced Plastics Group, SPE New York Section. Tufaro's Restaurant, Corona (Queens), N. Y.

October 3
SPE Western New England Section. Bradley Field, Windsor Locks, Conn.

October 4
SPE Southern California Section. Scully's Restaurant, Los Angeles, Calif.

October 8
SPE Cleveland-Akron Section. Spanish Tavern, Brecksville, Ohio

October 10
SPE Newark Section. Military Park Hotel, Newark, N. J.

October 11-12
SPI New England Section Conference. Wentworth Hotel, Portsmouth, N. H.

October 15
SPE Detroit Section. Rackham Memorial Bldg., Detroit, Mich.

SPE Southern Section. Mammy's Shanty, Atlanta, Ga.

October 16
SPE St. Louis Section. Melbourne Hotel, St. Louis, Mo.

October 17
SPE Chicago Section. Western Society of Engineers Bldg., Chicago, Ill.

SPE New York Section. Gotham Hotel, New York, N. Y.

October 18
SPE Eastern New England Section. Hotel Beaconsfield, Brookline, Mass.

SPE Ontario Section. St. Regis Hotel, Toronto.

October 24
SPE Philadelphia Section. Franklin Institute, Philadelphia, Pa.

Reinforced Plastics Group, SPE New York Section. Tufaro's Restaurant, Corona (Queens), N. Y.

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Names in the News (Cont'd from page 560)

Fred A. Jolles, Herbert R. Helbig, George C. Sweet, and **Sam Gurley, Jr.,** have been named vice presidents of Reichhold Chemicals, Inc., White Plains, N. Y. Dr. Jolles became vice president in charge of the foreign division; Mr. Helbig, vice president in charge of the export department; Mr. Sweet, vice president in charge of purchases; and Mr. Gurley, vice president in charge of sales development.

Positions Open

Display Rates $10.00 per Inch.

VINYL PLASTICIZERS SALES

Our Plasticizer Division is expanding rapidly with new products and applications. An opening exists for a technical salesman to work out of our New York office. Territory will comprise part of New Jersey and metropolitan area. Applicant should have at least two years selling experience in the vinyl industry on plasticizers or allied raw materials. Should have working knowledge of calendering, extrusion, molding and plastisol formulation. Age 25-35. Salary open. Send resume to:

Personnel Director
Archer-Daniels-Midland Co.
700 Investors Bldg.
Minneapolis, Minnesota

CHEMICAL ENGINEER

Eastern, medium-size progressive plastic company has excellent opening for aggressive young man. Must be capable of growth with the organization. Should have had at least two years experience in pilot plant set-up or in process research and development. Give complete resume of education, experience and salary requirements. All replies kept strictly confidential. Reply to Box 65,

PLASTICS TECHNOLOGY
386 FOURTH AVENUE, NEW YORK 16, N.Y.

MECHANICAL ENGINEER

Medium-size progressive, eastern plastic manufacturer has excellent opening for aggressive young man to be in charge of Fabrication Department (Nylon and Teflon products). We require at least three years production experience in similar activity. This is a real opportunity for a top-notch individual who desires to grow with our expanding organization. Give full details regarding education, experience and salary requirements. All replies kept strictly confidential. Reply to Box 66,

PLASTICS TECHNOLOGY
386 FOURTH AVENUE, NEW YORK 16, N.Y.